# Part 3:
# Advanced Corporate Valuation: Modelling Terminal Value with Stable Ratios in the Discounted Cash Flow Model, Deriving Implied Multiples, and the Bridge between Equity Value and Enterprise Value

## Chapter 22: Overview of Practical Issues when Computing Terminal Value that Arise because Unlike Humans and Machines, Corporations are Supposed to Last Indefinitely

When thinking about the most important things that affect valuations in corporate analysis, mistakes from developing economic assumptions for revenues are the most serious source of error. As discussed in Part 1, classic and recurring valuation problems arise from: (1) assuming that firms in industries with relatively easy entry can indefinitely earn a rate of return substantially higher than the cost of capital; (2) ignoring the effects of looming increases in capacity in an industry that outpaces growth in demand; (3) relying on opinions and analysis of big companies, famous consulting firms, well respected experts and others who are not making the same kind of investments as you are; (4) believing in fancy new fangled valuation analysis that supposedly produces value from factors other than producing a return above the cost of capital; (5) accepting optimistic forecasts of companies that are trying to increase or maintain returns in the face of increasing competition and who hide information through using incomprehensible financial jargon; and (6) misjudging shifts in cost structures and demand in an industry that can quickly render existing assets obsolete. While avoiding these types of pitfalls from making bad assumptions and having good business judgment is the basis for any valuation, there are also some mechanical issues that can have important distortions on measuring the value of a corporation. Many of these problems are related to measurement of terminal value, use and interpretation of P/E and EV/EBITDA multiples, computation of weighted average cost of capital, and correctly measuring the difference between enterprise value and equity value.

Unlike humans, single project financed investments or male/female relationships, corporations are assumed to last indefinitely. This means that when making a valuation, one could either make a forecast that goes out for hundreds or years or one could stop the forecast at some arbitrary date a few years from now and compute the value at that date. The latter approach of arbitrarily stopping the forecast sometime in the not too distant future involves computing terminal value and it is the only practical way to make a valuation analysis of a corporation. In virtually any analysis that is derived from an explicit period of earning free cash flow or dividends followed by realizing a lump-sum terminal value, it is the explicit or implicit assumption used to derive the terminal value that generally has the largest influence on valuation. Coming up with a terminal value includes explicit or implicit assumptions about the three fundamental items that affect the value of anything: (1) how the corporation will be able to earn returns in the long run; (2) what will the risk or cost of capital be for the corporation and (3) what is a sustainable growth rate over an indefinite period in the future. To reflect these items in the terminal value of a corporate model you should measure the weighted average cost of capital; you must compute the bridge between enterprise value and equity value; you may derive P/E and EV/EBITDA multiples, and it is best if you incorporate stable rates of depreciation, capital expenditures, deferred taxes, working capital and other items in the terminal period.

The next few chapters that address terminal value, multiples and other issues specifically related to corporate valuation are not intended to be a typical textbook treatment of discounted cash flow analysis that describes how to compute free cash flow and then add the terminal value and discount the cash flow at the WACC. Instead, the focus is on biases that occur in the valuation analyses that arise from incorrectly considering stable rates of earnings growth, capital expenditures, deferred taxes and working

capital. Further, when addressing valuation from P/E, EV/EBITDA and market to book multiples, issues like how to select comparable company samples for applying the P/E and EV/EBITDA ratios are not the primary focus. Financial models are used to demonstrate which factors – asset life, inflation, growth, risk premium, return, taxes and fade periods or transition factors for each variable -- are the most important drivers of the multiples. Concepts of stable ratios of capital expenditures, deferred taxes given tax and book lives are demonstrated in computing multiples when growth rates, returns and cost of capital is changing over time.

Many ideas about valuation such as the definition of the weighted average cost of capital, free cash flow and net debt are taken for granted by finance professionals, students and academics without working through the underlying valuation logic and are wrong. For example, when applying the discounted cash flow in a model, the terminal value is universally discounted at the same rate as the free cash flow over the explicit period, even though the company is assumed to have stable cash flow after the terminal period and should be less risky with less volatile cash flow. Similarly, the common practice of de-levering and then re-levering the beta in applying the discounted cash flow model is mathematically incorrect if the cost of debt is different from the risk free rate. Another important example of an error is the technique of computing terminal value using the value driver formula that includes returns, growth and the cost of capital (1-g/ROIC)/(WACC-g) contains a large number of implicit assumptions and biases that are very difficult to dissect and impossible to properly interpret. In the next few chapters explanations are presented as to how one can potentially avoid the many distortions in the terminal value calculations and other aspects of discounted cash flow analysis in corporate models. Some of the modelling issues addressed in this part of the book relating to terminal value, multiples and stable ratios include:

- How can you make reasonable explicit or implicit assumptions with respect to the long-term growth, profitability and risk that are required in terminal value calculations and derivation of multiples? For companies that are growing faster than the overall economy and that are earning returns substantially above their cost of capital, one generally should assume that growth and returns stabilize. The problem is that the time frame for stabilization, the transition speed of the movement to stabilization and the level of long-term profitably are virtually impossible to predict. The first step is admitting that this is a problem in the DCF analysis that cannot be resolved by elegant financial theory, fancy excel models or simplistic assumptions.

- When you make a growth rate assumption, how is valuation affected by the type of growth you are really assuming? If the growth rate changes from 15% to 3%, the decline in growth may be due to (1) sales declines where the return on invested capital stays constant; (2) declines in the return on investment which cause revenues to fall; or (3) declines in expenditures for capital expenditures and working capital investment with a constant return. Depending on which factor drives the growth rate, the terminal value will differ.

- How should cash flows in the stable period that is the basis for terminal value be adjusted when different assumptions are made for growth rates, profitability and cost of capital over time? Revising free cash flow in the terminal period to reflect normalized cash flow is important for the simple reason that when EBITDA is assumed to grow faster, then capital expenditures that support that EBITDA growth should also grow faster as should working capital investment and deferred taxes. Mechanically, this means the ratio of depreciation to net plant, the ratio of capital expenditures to depreciation, the ratio of deferred taxes to capital expenditures and the ratio of the movement in working capital to EBITDA must change when the growth rate changes. It is therefore be very wrong to assume (as many people do) that the terminal growth rate can be input without also changing a variety of other relationships for normalized cash flow in the terminal period.

- How should the ratio of capital expenditure to depreciation be applied in a model after a change in growth rate when it takes a full life cycle of plant before the rates stabilize? If the growth rate in investment changes from 10% to 5% and assets have a 20 year life, then it takes 20 years before a new ratio of depreciation to net plant is achieved. This is unlike working capital investment which changes immediately after a growth rate change. The stable or equilibrium condition for

normalized cash flow should establish a set of consistent parameters including capital expenditures to depreciation, depreciation rates on net plant, working capital changes to EBITDA and deferred taxes as a percent of capital expenditures that include transition effects that occur over the lifecycle of the investment.

- How can you compute implied P/E ratios, EV/EBITDA ratios and market to book ratios from stable growth rates along with assumptions about the cost of capital after an assumed stable period is reached? Deriving multiples is a reasonable way to avoid many of errors that regularly occur in computing terminal value and can account for changes in growth rates, stable ratios of depreciation and other factors. The ratios can avoid impossible to resolve pitfalls in the value driver formula [TV = NOPLAT x (1-ROIC/g)/(WACC-g)] that computes terminal value from ROIC, growth and cost of capital. Further, implied multiples can be used to compute terminal values that are adjusted for assumed transition periods where one needs to work through an entire life cycle of plant as a transition period.

# Chapter 23: Benefits of Carefully Computing the Return on Invested Capital for Historic and Projected Periods in Corporate Models to Check the Reasonableness of the Forecast, Understand where Value Comes From and to Dissect the Structure of a Company's Balance Sheet

The value of any investment comes from the ability to earn a return above the cost of capital and the growth rate in sales or income. Given this most basic proposition in finance, the return on investment and the growth rate should be prominently presented in the summary section and in other areas of a corporate financial model. You could compute hundreds of different ratios from financial statements generated by a model, but the key ratio that ultimately drives the value of a company and also demonstrates the reasonableness of the assumptions for the model is the return on equity and/or the return on invested capital. These rate of return statistics measure the amount of investment that providers of capital have made in the company (either directly or indirectly through not taking dividends when earnings are created) relative to profit that is generated. To illustrate how returns are important in checking assumptions, pretend that the return on investment was 10% in the historic period but your forecast assumes the return increases to 30%. You then better have a very good story using economic fundamentals (competitive position, cost structure and so forth) and proving that the competitive position of the firm becomes stronger to explain why the return is increasing and for how long the increase can be sustained. You can create a highly sophisticated model with careful development of detailed assumptions, but if you do not show the return on investment, your model is not really complete.

## When Developing a Model, You Can Work with Either a Free Cash Flow Perspective, an Equity Cash Flow Perspective or Both in Computing Financial Ratios and Valuation

Some people become emotional about whether it is better to focus on the return on equity or return on invested capital in measuring the performance of a company. This issue comes from a more general debate as to whether value should come from equity cash flows or free cash flows. While there is important and subtle reasoning underneath the free cash flow versus equity cash flow arguments, when making a financial model it is usually a good idea to include both free cash flow and equity cash flow perspectives when demonstrating value. The various measures of profitability, cost of capital, rate of return, value and other ratios from a free cash flow and from an equity cash flow perspective are shown below. At this point in the discussion of corporate modelling and valuation it is best not to get too excited about which side of the column you should use. Instead, it is useful to keep equity valuation measures consistent with equity returns, equity cash flows and equity cost of capital and do the same for the free cash flow column.

| Item | Equity Cash Flow | Free Cash Flow |
| --- | --- | --- |

| | | |
|---|---|---|
| Cost of Capital | Cost of Equity (k) | WACC |
| Value Measure | Market Capitalization | Enterprise Value |
| Income | Net Income | NOPLAT (EBIT x (1-t)) |
| Profitability | Return on Equity | Return on Invested Capital |
| Growth | Earnings Growth | Asset Growth |
| Earnings Valuation | P/E Ratio | EV/EBITDA Ratio |
| Market Valuation | Market to Book | EV/Invested Capital |
| Rate of Return | Equity IRR | Project IRR |
| Present Value | PV of Equity Cash Flow | PV of Free Cash Flow |
| Value Driver Formula | (1-g/ROE)/(k-g) | (1-g/ROIC)/(WACC-g) |

If a company does not have non associated investments, surplus cash, discontinued operations, unfunded pension liabilities, deferred taxes, deferred provisions, fair valuation of derivatives or other complicated items on its balance sheet, the return on equity can easily be reconciled to the return on invested capital. For this simple balance sheet case, the return on invested capital can be computed in an analogous way to return on equity where debt is included along with equity in the denominator as illustrated below. The return on debt is the interest expense plus the interest tax shield divided by the net debt and taxes are net income multiplied by t/(1-t). Using these two equations it can be demonstrated that:

EBIT x (1-t) = NI + Net Interest x (1-t)

and,

Return on Equity = Net Income/Equity Invested

and,

Return on Debt = Net Interest Expense x (1-t)/Net Debt Capital

combining the two implies,

Return on Capital = (Net Income + Net Interest x (1-t))/(Equity + Net Debt)

which means,

Return on Capital = EBIT x (1-t)/Capital Invested

In this special simple balance sheet case, it is easy to see that the return on invested capital equals the return on equity if the firm is financed with no debt when interest and debt are eliminated from the equation. When writing the formulas above, given the frequency of using EBIT x (1-t) in the ROIC formula and in other circumstances, the number is often labelled NOPAT or net operating profit less adjusted taxes. Therefore, the definition of return on invested capital becomes:

ROIC = NOPAT/Invested Capital.

In the above formula, invested capital was simply assumed to be equal to the level of debt plus the level of equity. Because the balance sheet balances, the sum of debt and equity equal total assets. This means the level of invested capital could be replaced by the term net assets that generate EBITDA. Therefore, an alternative definition of return on invested capital is:

ROIC = NOPAT/Net Assets that Generate EBITDA

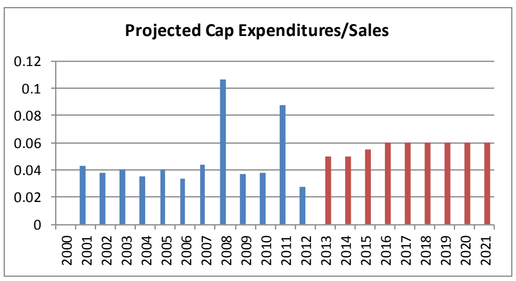
This alternative definition of ROIC is relevant in corporate models because it can be computed before the financial structure of the model is developed (after EBITDA, capital expenditures, working capital and

depreciation). The net assets that generate EBITDA include items such as net working capital and net plant assets which are part of the free cash flow development of a model. Therefore, you can compute the ROIC before you work through all of the debt schedules, the income on non-associated assets and other items. This is similar to computing the project IRR for project finance models. When evaluating whether the assumptions are reasonable, an argument for focusing on the ROIC rather than the ROE is that the ROE is affected by changes in the capital structure, assumptions with respect to other income, dividend policy, interest rate changes and other factors. By reviewing the ROIC you can make sure that your evaluation is not affected by these other items. As explained in the next chapter, the more refined definition of invested capital should be invested capital associated with activities that generate EBITDA.

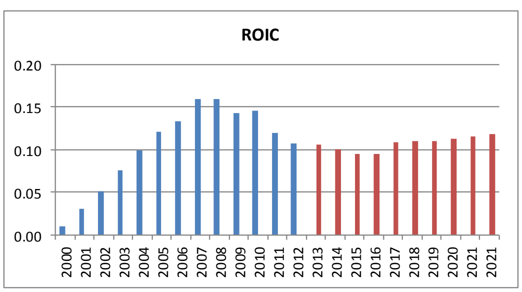
## Some Ideas in Effectively Presenting Return on Invested Capital in Financial Models

A summary page that presents the historic and projected ROIC below assumptions is presented below. In the example, one can select from a list of different assumptions on the top panel; show various financial ratios on the bottom panel and look at the valuations in different scenarios in an area adjacent to the graphs. When creating a page that summarises the entire model, it is useful to allow presentation of a host of different assumptions next to historic levels and observe what happens to the rate of return. Along with the returns and assumptions, inclusion of a drop-down box that contains the various different scenarios allows you to see how changing an assumption affects the returns and whether the assumption is reasonable in light of history.

Projected Cap Expenditures/Sales




ROIC




Scenario: Custom Case

| | |
|---|---|
| Valuation Year | 2012 |
| Terminal Year | 2019 |
| WACC | 8% |

| DCF Analysis | Growth rate method Growth Rate | Value driver method ROIC/WACC | Input EV/EBITDA EV/EBITA | Computed EV/ EBITDA EV/EBITA |
|---|---|---|---|---|
| | 2% | 2% | 9 | 10 |
| Enterprise Value | 3,915,826 | 3,565,186 | 2,576,648 | 3,828,561 |
| Equity Value | 3,544,494 | 3,193,854 | 3,135,171 | 3,135,171 |
| Terminal EV/EBITDA | 6.09 | 5.37 | 9.00 | 10.00 |
| **Value/Share** | **26.18** | **23.59** | **23.16** | **25.54** |

Cost of Equity 8%

| Equity Cash Flow | Growth rate method Growth Rate | Value driver method ROE/ROE | Input PE P/E | Computed P/E P/E |
|---|---|---|---|---|
| | 4% | 4% | 13 | 12 |
| PV of Dividends | 4.69 | 4.69 | 4.69 | 4.69 |
| Terminal Value | 15.69 | 13.17 | 10.28 | 9.49 |
| **Total Value** | **20.42** | **17.87** | **14.97** | **14.18** |

In creating such a summary page, the following step-by-step process can be used:

Step 1: Create a section of the model where you put all of the assumptions and their values as well as the financial ratios and their values. Link the titles and the values of the assumptions and the financial ratios without any blank rows so that you can create a combo box.

Step 2: Insert a dropdown box and use the INDEX function below the assumptions and the financial ratios that allows you to select one of the assumptions and one of the financial ratios. The accumulation of financial ratios in a section and the addition of a dropdown box is illustrated below (see Part 3 for details about how created drop-down boxes like this).

**Financial Ratios**

ROIC
ROE
ROIC
EBITDA Margin
Capital Expenditures to Deprecia
Debt to Capital
Debt to Equity
Debt to EBITDA
EBIT to Interest
Earnings per Share
Earnings
EBITDA
Revenues

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ROE | ROIC | -16.47% | -2.54% | -2.79% | 2.50% | 8.85% | 11.32% | 15.07% |
| ROIC | | 0.95% | 3.04% | 5.18% | 7.55% | 9.88% | 12.05% | 13.39% |
| EBITDA Margin | | 4.92% | 7.75% | 9.23% | 9.07% | 8.96% | 9.24% | 9.51% |
| Capital Expenditures to Depreciation | | | 98.07% | 87.78% | 107.82% | 96.34% | 115.79% | 97.55% |
| Debt to Capital | | 37% | 32% | 35% | 10% | 8% | 15% | 13% |
| Debt to Equity | | 55% | 46% | 50% | 11% | 9% | 17% | 15% |
| Debt to EBITDA | | 3.59 | 2.81 | 2.40 | 0.47 | 0.36 | 0.56 | 0.48 |
| EBIT to Interest | | 0.15 | 2.84 | 24.04 | 40.52 | 124.66 | 27.76 | 23.44 |
| Earnings per Share | | -2.76 | -0.32 | -0.38 | 0.22 | 0.77 | 0.66 | 0.89 |
| Earnings | | (82,764.00) | (14,293.00) | (16,955.00) | 14,658.00 | 50,774.00 | 61,231.00 | 81,043.00 |
| EBITDA | | 77,247.00 | 100,664.00 | 122,643.00 | 131,820.00 | 138,976.00 | 158,630.00 | 179,655.00 |
| Revenues | 2 | 1,568,934.00 | 1,299,490.00 | 1,328,607.00 | 1,452,995.00 | 1,551,308.00 | 1,715,869.00 | 1,888,654.00 |
| | | | | | | | | |
| ROIC | | 0.95% | 3.04% | 5.18% | 7.55% | 9.88% | 12.05% | 13.39% |
| | | | | | | | | |
| | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
| ROIC | | 0.95% | 3.04% | 5.18% | 7.55% | 9.88% | 12.05% | 13.39% |
| | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |

Step 3: Once you have the selected ration from the INDEX function, create two additional rows that split the selected variable between historic and projected levels using the historic period switch and then make a graph using the F11 key. Move the graph of both the assumptions and the financial ratios onto the summary page.

Step 4: Sometimes there is a irritating problem of setting the minimum scale. To fix this you can first create a function to round and compute the minimum after rounding. Then you can create a macro to adjust the scale on the graph and set the lower scale to the number generated from the minimum function.

While this part of the book generally deals with corporate finance models, there are some analogies to project finance analysis where stable terminal periods and terminal values are less of an issue. When creating a project finance model the recommendation made in Part 1 was to begin the model by computing free tax cash flow (EBITDA less capital expenditures). After free cash flows are established, depreciation expense was the next step in the process which allows you to compute free cash flow and the after tax project IRR. In a project finance model it does not make sense to compute the return on invested capital because as a plant depreciates and dividends are paid, the level of invested capital declines. If the EBITDA is stable or increases over time, the return on investment increases over the life of the project meaning that assessing the return on invested capital does not tell you much about the investment. When creating a project finance model, the project IRR is a good place to stop and take a break because if the project IRR is below the interest rate on debt, it is doubtful that the project will proceed. The project IRR therefore provides a sanity check on the model before other complicated details involving debt structuring are programmed. For a corporate finance model, the analogy to computing the project IRR is to compute the return on invested capital which should also be independent of financing. If computed correctly, the return on invested capital measures the return on all capital provided from the primary business activities of the company. As is the case for the project IRR, the return on invested capital is not affect by whether a company (like Apple) has 100 billion of cash on its balance sheet or if it has 90% leverage. These financial aspects of a company may change over the forecast horizon but they do not affect the return on invested capital. It is for this reason that the return on invested capital is such a convenient ratio in checking whether you have made reasonable assumptions and explaining why the value of a company is changing in different scenarios.

Before proceeding to the next section of the model where detailed mechanics of the return on invested capital calculation are presented, a couple of real world problems with computing the return on invested capital should be noted. If a company has a large impairment of plant, the equity balance and the invested capital balance will suddenly decline which decreases both equity investment and invested capital. In subsequent years, the return on invested capital will have a higher values than they would have had the write-off not occurred. A similar problem occurs after a large impairment to goodwill or a large re-structuring charge. Alternatively, after a large acquisition goodwill and intangible assets increase that can cause the return on invested capital to suddenly fall. In these cases with write-offs and acquisitions you should be cautious about interpretation of the return on invested capital and in particular attempting to make comparisons between the return on investment and the cost of capital. Sometimes it

may be preferable to re-compute the invested capital without write-offs or goodwill for purposes of evaluating the fundamental performance of the company.

# Chapter 24: Detailed Calculation of Invested Capital that Forces You to Understand the Financial Structure of a Corporation and the Mechanics of Computing the Return on Invested Capital Using the Guiding Principle that Relates Balance Sheet Items to EBITDA

In computing the invested capital when developing the ROIC, the general idea is to dissect the balance sheet and split items that are related to generating EBITDA (such as net plant) from items that produce income an expenses other than EBITDA (such as debt which generates interest expense). While it may seem mundane and relatively simple to establish asset and liability items that should be included in the invested capital because they are related to producing EBITDA, the process can in fact be quite tricky. A whole (relatively long) chapter is devoted to this subject because when computing invested capital for purposes of ROIC, the mechanics of making this segregation are important in many valuation and financial modelling contexts and have some important key side benefits. Three of these benefits include:

1. Once balance sheet items are identified and segregated on the basis of those that lead to the generation of EBITDA, the same segregation process that is used in the invested capital calculation can be used to evaluate the difference between equity value and enterprise value when computing discounted cash flow. However in computing the difference between equity value and enterprise value, all of the items should be measured at market value rather than book value.

2. When measuring enterprise value from market capitalisation in computing the EV/EBITDA ratio or deriving the aggregate value in an acquisition from equity consideration, it is also necessary to identify items that bridge the enterprise value with the equity value. Items that form this bridge (and should be measured at market value) can be identified using the same thought process in segregating the balance sheet and computing invested capital.

3. When computing the WACC associated with free cash flow and measuring cost of equity with valuation metrics that are derived from equity cash flow such as equity beta, market to book ratio analysis or implicit cost of equity from the growth rate and the P/E ratio, a comprehensive set of items should be used in adjusting the WACC. The WACC calculation should not only include gross debt, but also surplus cash and all of the other items in the bridge between equity capital and enterprise value. Thus, all of the items identified for reconciling the invested capital calculation and for the bridge between enterprise value and equity value should also be included in the WACC calculation.

To illustrate the general process of segregating balance sheet items for purposes of computing invested capital, assume a company has associated investments on the balance sheet and other income from associated investments on the profit and loss statement that is not included in EBITDA. The income from associated assets is not included in the numerator of the ROIC calculation because it is not included in EBIT x (1-t). This means the investment in associated assets should also not be included in the denominator of the ROIC calculation. In this situation, some of the debt and equity that is tabulated as the invested capital of the company is implicitly used to finance the associated investments. As there is less financing for core EBITA producing assets, the amount of debt and equity on the balance sheet associated with financing EBITDA should be reduced by the associated investments. Because free cash flow is driven by EBITDA, the present value of free cash flow and the enterprise value also does not include the income generated from investments in associated companies. But the income from associated investments does accrue to the equity owners of the company owners of the company – these assets presumably do have some value if they are generating income. This means that the value of investments in associated companies should be added to the enterprise value when establishing equity value. The manner in which the associated investments is an adjustment to the invested capital calculation and at the

same time an adjustment in moving form enterprise value to equity value is the same for many other items on the balance sheet.

## Making Invested Capital Calculations that Force you to Dissect the Financial Structure of a Corporation and Understand Items that Cause the Enterprise Value to Differ from Equity Value

Determining what items should be included and not included in the invested capital calculation can be confusing until you strictly follow the principle that items which do not generate on-going EBITDA should not be part of invested capital. Further, because the level of invested capital comes from items on the balance sheet and because the balance sheet must balance, invested capital can be computed from an indirect or a direct perspective as explained below:

- The first perspective (the indirect and commonly applied method) is beginning with debt and equity capital provided to generate EBITDA. From the debt and equity capital perspective, any asset or liability that provides cash flow that is below the EBITDA line should not be included in EBITDA and any liability that involves finance costs should be included in invested capital. This perspective is labelled the financing perspective in the discussion below.

- The second perspective is directly identifying assets and liabilities that are associated with producing EBITDA. For example, the balance of net plant, the level or accounts receivable and the level of accounts payable are directly associated with the operations of a company and the EBITDA. This perspective is labelled the net asset producing EBITDA perspective below.

Both of the perspectives should provide the same answer and it is a good idea to compute the invested capital necessary to generate EBITDA both ways to make sure you have worked through the entire balance sheet. After you have reconciled both methods and assured that you end up with the same invested capital number, you have completed a lot of the process for identifying items that are in the bridge between equity capital and enterprise value. Items other than equity capital using the first perspective do not affect enterprise value but are part of the equity value of the company.

The excerpt below illustrates how invested capital can be derived beginning with the liability side of the balance sheet and subtracting net assets that do not produce EBITDA or alternatively from the asset side of the balance sheet. Note the test below the two calculations that verify the equality of both approaches. The second perspective is that of including net assets that do generate EBITDA. The top part of the excerpt is consistent with adjustments that are made in moving between the enterprise value and the equity value when computing either the equity value in a discounted cash flow analysis or the EV/EBITDA ratio. On the other hand, the lower section of the calculation includes items such as current assets, net plant and current liabilities that should be computed when evaluating operating cash flow and working capital in the initial part of a model. The exercise of computing invested capital in this manner assures that you have not left anything out and have considered which side of the ledger every item should be on as a function of whether it does or does not generate EBITDA. The next paragraphs of this chapter discuss how to classify various items that may appear on the balance sheet of a company between the two sections below.

| Timeline | Custom Case | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Historic timeline switch | 13 | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE |
| Explicit period switch | 8 | TRUE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE |
| Valuation year | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE |
| Closing Balance Sheet for valuation | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE | FALSE |
| Terminal value switch | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| ROIC | | | | | | | | | | | |
| **Invested Captial - Perspective of Capital Funding EBITDA** | | | | | | | | | | | |
| Equity Capital | | | 562,863.00 | 656,215.00 | 634,719.00 | 715,945.00 | 795,790.00 | 758,968.00 | 858,620.00 | 904,866.13 | 950,206.53 |
| Minority Interest | | | 5,870.00 | 7,802.00 | 9,335.00 | 12,081.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gross Debt | | | 86,532.00 | 29,428.00 | 286,417.00 | 251,668.00 | 127,302.00 | 326,174.00 | 607,012.00 | 638,689.57 | 641,308.63 |
| Pension Obligations | | | 146.00 | 0.00 | 78,897.00 | 68,140.00 | 76,086.00 | 155,263.00 | 159,158.00 | 159,158.00 | 159,158.00 |
| Total Capital | | | 655,411.00 | 693,445.00 | 1,009,368.00 | 1,047,834.00 | 999,178.00 | 1,240,405.00 | 1,624,790.00 | 1,702,713.70 | 1,750,673.16 |
| Less: Cash | | | 13,914.00 | 19,978.00 | 19,964.00 | 18,948.00 | 6,755.00 | 7,783.00 | 13,275.00 | 0.00 | 0.00 |
| Less: Non-Associated Investments | | | | | | | | | | | |
| Less: Net Derivative Assets | | | | | | | | | | | |
| Less: Notes Receivable | | | 74,428.00 | 88,469.00 | 94,652.00 | 94,457.00 | 92,860.00 | 102,322.00 | 102,723.00 | 102,723.00 | 102,723.00 |
| Total Invested Capital | | | 567,069.00 | 584,998.00 | 894,752.00 | 934,429.00 | 899,563.00 | 1,130,300.00 | 1,508,792.00 | 1,599,990.70 | 1,647,950.16 |
| | | | | | | | | | | | |
| **Invested Capital - Perspective of Net Assets Generating EBITDA** | | | | | | | | | | | |
| Current Assets | | | 216,523.00 | 247,393.00 | 293,534.00 | 299,293.00 | 305,864.00 | 334,523.00 | 421,978.00 | 479,063.29 | 500,623.30 |
| Net Plant | | | 464,442.00 | 486,522.00 | 587,196.00 | 602,576.00 | 604,693.00 | 685,487.00 | 725,836.00 | 772,589.06 | 815,863.41 |
| Goodwill | | | 75,537.00 | 76,338.00 | 200,035.00 | 201,682.00 | 200,153.00 | 219,730.00 | 269,897.00 | 269,897.00 | 269,897.00 |
| Other Assets Used in Business | | | 50,067.00 | 66,972.00 | 119,118.00 | 113,772.00 | 114,069.00 | 167,889.00 | 432,942.00 | 432,942.00 | 432,942.00 |
| Less: Current Liabilities | | | 177,836.00 | 206,725.00 | 242,531.00 | 196,009.00 | 214,340.00 | 225,651.00 | 282,962.00 | 287,604.60 | 296,082.62 |
| Less: Deferred Taxes | | | 35,715.00 | 49,111.00 | 16,765.00 | 43,034.00 | 65,585.00 | (889.00) | 10,008.00 | 18,005.04 | 26,401.93 |
| Less: Other Current Liabilities | | | 25,949.00 | 36,391.00 | 45,835.00 | 43,851.00 | 45,291.00 | 52,567.00 | 48,891.00 | 48,891.00 | 48,891.00 |
| Total Invested Capital | | | 567,069.00 | 584,998.00 | 894,752.00 | 934,429.00 | 899,563.00 | 1,130,300.00 | 1,508,792.00 | 1,599,990.70 | 1,647,950.16 |
| | | | | | | | | | | | |
| Test | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |

A similar process to reconciling invested capital can be developed for determining the aggregate value of a transaction. This aggregate value can be used in an analogous way that capital expenditures without interest are presented in a project finance model. Once the aggregate value is computed, you can compute the overall un-geared IRR on the transition before taxes and after taxes. The aggregate value should stay the same no matter how the acquisition is financed and can be in an indirect method using the amount of money that is paid for the company net of bridge items that remain with the company after the acquisition. Alternatively, the aggregate value can be computed from the equity consideration paid plus all of the bridge items that produce cash flow for the equity investors. An example of the way such a reconciliation can be presented is shown in the table below.

| **Entreprise Value Reconciliation** | |
|---|---|
| ***Enterprise Value from Transaction Data*** | |
| Total Equity Paid | 138.66 |
| Total Debt Issued Net of Fees | 411.05 |
| Add: Pensions | 60.00 |
| Less: Notes Receivable | -130.00 |
| Total | 479.70 |
| | |
| ***Enterprise Value from Balance Sheet Data*** | |
| Consideration | 470.00 |
| Fees | 4.70 |
| Dividends Paid | 40.00 |
| Debt | 120.00 |
| Add: derivative liabilities | 30.00 |
| Add: Pensions | 60.00 |
| Less: Surplus Cash | -40.00 |
| Less: associated investments | -75.00 |
| Less: notes receivable | -130.00 |
| Total | 479.70 |

## The General Idea of Drawing an Imaginary Line Underneath EBIT and Dividing Up Assets and Liabilities According to Whether they Produce Income or Incur Expenses Above or Below the Line

The important and tricky part of the process of computing the return on invested capital is determining whether a balance sheet item is or is not associated with generating on-going EBITDA. Using EBITDA to guide which side of the invested capital ledger to place an item is not always clear from the title of an item on the balance sheet or from a theoretical perspective. Further, it is difficult to come up with a simple checklist that can be used in every case to split-up the balance sheet for purposes of computing invested capital or the bridge between enterprise value and equity value. In deriving invested capital from the perspective of funding, you can begin with equity capital including minority interest. All of the short-term debt, long-term debt capital leases and other items that carry an interest charge should be included in the invested capital using the indirect perspective as long as the interest expense is not included in EBITDA. While this is often straightforward, somewhat more complex items involve pension liabilities, long-term notes and accounts receivable, vendor financing, derivatives, stock options, decommissioning provisions, deferred taxes and operating cash. For example, if a vendor gives the company an interest free loan that at the same time increases expenses that are part of EBITDA, then the vendor loan should not be part of invested capital. On the other hand if the loan includes interest and does not affect the EBITDA it should not be in invested capital.

To illustrate the thought process behind the guiding principal of EBITDA, consider the example of long-term notes receivable and long-term accounts receivable. A company may provide loans to other associated companies or to non-associated companies that produce some kind of interest income. If the loan interest is not included in the free cash flow that establishes enterprise value, then the notes receivable, whether classified as long-term notes or short-term notes should be part of the bridge between enterprise value and equity value. When the notes are redeemed, cash flow will be realized by investors and it should not be part of EBITDA or free cash flow. If the notes receivable are made at below market rates of interest, then the market value of the notes included in the bridge should be lower than the amount that is recorded on the balance sheet. A long-term account receivable should in general in theory be similar to a notes receivable and the timing of when the receivable is not relevant in valuation. The treatment of a long-term receivable depends if it is a one-off item and it is not directly or indirectly included in EBITDA and free cash flow used to compute enterprise value. If the long-term accounts receivable is not expected to recur and if the redemption of the accounts receivable is not already included in free cash flow (as an increase from lower working capital), then it should be included in the bridge between equity value and enterprise value. Otherwise redemption of the long-term receivable is included in the free cash flow no adjustment is necessary.

On the liability side, the guiding principle of EBITDA is illustrated by the case of un-funded pension obligations that arise from not placing sufficient funds in a trust fund to cover liabilities created from defined benefit plans. These liabilities should be excluded from direct calculation of invested capital and included as comparable to debt. To demonstrate this, consider two companies, one with a surplus in its pension trust fund and another with a liability for unfunded pension obligations. For the company with the pension surplus, part of the debt and equity investment in the company made by investors it was implicitly to finance the extra amount in the pension fund and the amount of cash taken from equity investors will be reduced in the future. As the investment attributed to the surplus pension fund does not generate EBITDA, it should not be include in the invested capital associated with NOPLAT. Where the company has a deficit in the pension plan, the principle is the same. Here, not enough debt and equity have been invested to support the NOPLAT and the EBITDA meaning that the invested capital must be increased.

Distinguishing between accounts receivable and inventory other related current assets on the one hand and surplus cash on the other hand illustrates the process of segregating balance sheet accounts. If a company would stop operating today, the accounts receivable and inventory would produce cash flow for shareholders just like the surplus cash. However, there are key differences between these current asset items and the surplus cash. First, the implicit finance cost of accounts receivable and inventory is incorporated in EBITDA and enterprise value. If a company demands faster payment to reduce accounts receivable balances, the reduction in these balances will probably force the company to reduce prices or may lower the volumes of sales. Alternatively, if a company is more generous with payment terms, revenues and EBITDA should increase. In both cases the financing effects of accounts receivable are part of the EBITDA. Similarly in the case of inventories, the company could reduce its inventory, but may have to increase the cost of goods sold implying that financing effects of the inventories are included in the EBITDA. By contrast, there should be no relationship between surplus cash and EBITDA as the income from surplus cash should be recorded as interest income. Second, unlike surplus cash, the accounts receivable items are necessary in order to produce the free cash flow and are therefore incorporated in enterprise value. Third, as long as the firm is in existence and growing, the value of accounts receivable and inventories will never be realized as cash flow to equity investors because previous accounts receivable are replaced with investments in new accounts receivable and old inventories are replaced with new inventories.

## Constructing a Long-term Model to Create Proofs of How Various Items Should be Treated in Various Valuation Problems

When attempting to segregate different items and computing how the item affects value, people often make general arguments that can be disputed by an counter arguments and a lot of time is wasted by smart people having quasi political beliefs about the treatment of different of issues. For example in arguing that accumulated deferred taxes should be included in the indirect calculation of invested capital, an analyst noted that: “Buffett's Berkshire has over $50b in deferred tax liability, and he brags about it for over 30 years now more as a source of 'asset' financing than a pure liability reality. Hence, I think deferred taxes are a form of financing (and hence included in invested capital).” Rather than wasting a lot of time on this type of argument, a long-term model can be developed to prove how the item is treated. As long as you understand the accounting and the cash flow implications of various issues, you can use the long-term analysis to resolve many issues.

The mechanics of the long-term analysis described below are applicable to a number of subjects addressed in this part of the text. Later on, questions about whether the value driver formula (1-g/ROIC)/(WACC-g) really works and how to compute stable levels of capital expenditures relative to depreciation are addressed with this framework. Long-term analysis is necessary because of the general notion that corporations last indefinitely and do not die like project financed investments, humans and relationships. The long-term analysis follows the following step by step process:

Step 1: Set-up long-term analysis with that includes growth rate and discount rate assumptions as well as cash flow generated to equity holders and the accounting aspects of the problem.

Step 2: Input a valuation year after the start of the model so that balance sheet items (such as accumulated deferred taxes) can be evaluated for purposes of the valuation.

Step 3: Compute the true value of the cash flows using the long-term analysis.

Step 4: Use the same assumptions to create a discounted cash flow model with a terminal value and a bridge between equity value and enterprise value.

Step 5: Evaluate the difference between the equity value computed in step 4 and the equity value computed in step 3.

To illustrate the manner in which a long-term model can resolve issues, consider the simple case of accounts payable. One could potentially make the argument that accounts payable are not unlike other debt obligations that come due and are included in the indirect method of computing invested capital. However, unlike other forms of debt, the implicit cost of delaying payments from suppliers is part of EBITDA. If a supplier offers very attractive payment terms but at the same time increases the cost of supplying materials, this increased cost is included as an operating expense and implicitly part of EBITDA. In addition to the financing cost, the treatment of payables is affected by the question of whether the level of accounts payable changes over time. In general, the accounts payable are assumed to increase with the growth of the company implying that the accounts payable provide cash flow and are never a liability that must be repaid. If the accounts payable continue to grow and the growth is included in the working capital changes in the free cash flow, then there is no cash flow that must be incurred by equity investors that is not already included in free cash flow (as changes in working capital). Indeed, the accounts payable never really come due as a cash obligation to equity investors. Instead, they are replaced by new payables and the implicit financing cost is included in the operating expenses.

To use the long-term model in demonstrating the appropriate treatment of accounts payable, the example below assumes a sales growth rate of 5%, and operating margin of 30% (implying that expenses are 70% of sales), a WACC of 10% and an assumption that expenses are paid in 100 days. In modelling the accounts payable, the increase in true cash flow that is paid is to suppliers is computed from the cash flow that is avoided in the current period (100 days or 27.4% of the operating expense). The true cash flow is the revenues less the outflow of cash to suppliers as illustrated in the excerpt below (the actual model extends to year 300).

To model the value assuming that the company is purchased in year five, a number of techniques that were introduced in Part 1 can be applied as follows:

1. Construct a period counter that extends to 300 years (the entire spreadsheet using 16,000 columns cannot be used and causes the spreadsheet to be slow and large). Use the SHIFT, CNTL, → and SHIFT, ALT, → keys to cut-off the sheet after deleting the columns after year 300.

2. Create a switch variable that is true when the period counter is greater than the valuation year (assumed to be 5).

3. To compute the value at the valuation year using the NPV function, you can replace the equity cash flows before the year in question with a FALSE value. If the cash flows before year five have a value of zero, then the present value of the cash flow accrues to the first year instead of year five. In order to place a FALSE in the cells rather than a zero for the first five years and use the NPV formula, use an IF statement without an argument for the false condition as illustrated below.

    Equity Cash Flow for Valuation = IF(Valuation period switch, Equity Cash Flow)

    Value = NPV(WACC, Equity Cash Flow for Valuation)

| | |
|---|---|
| **Assumptions** | |
| Sales Growth | 5.00% |
| Operating Margin | 30.00% |
| A/P Days | 100 |
| A/P as Percent of Expenses | 27.40% |
| WACC | 10.00% |
| Initial Level of Sales | 200.00 |
| Valuation Year | 5.00 |
| Explicit Period | 4.00 |
| Terminal Period | 9.00 |

**True Cash Flow to Equity**

| Period | Driver | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Valuation Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Sales | 5.00% | 200.00 | 210.00 | 220.50 | 231.53 | 243.10 | 255.26 | 268.02 | 281.42 | 295.49 | 310.27 | 325.78 |
| Operating Expenses | 70.00% | 140.00 | 147.00 | 154.35 | 162.07 | 170.17 | 178.68 | 187.61 | 196.99 | 206.84 | 217.19 | 228.05 |
| Operating Expenses Paid from Current Year Expense | 72.60% | 101.64 | 106.73 | 112.06 | 117.67 | 123.55 | 129.73 | 136.21 | 143.02 | 150.17 | 157.68 | 165.57 |
| Operating Expenses Paid from Prior Year Expenses | 27.40% | | 38.36 | 40.27 | 42.29 | 44.40 | 46.62 | 48.95 | 51.40 | 53.97 | 56.67 | 59.50 |
| Equity Cash Flow | | | 64.92 | 68.16 | 71.57 | 75.15 | 78.91 | 82.85 | 87.00 | 91.35 | 95.91 | 100.71 |
| Equity Cash Flow for Valuation | | | FALSE | FALSE | FALSE | FALSE | FALSE | 82.85 | 87.00 | 91.35 | 95.91 | 100.71 |
| True Value of Company | 1,657.07 | | | | | | | | | | | |

Once the true value has been established, a model that contains different theories of value using balance sheet items can be developed as illustrated below. In creating this model, you can start with the valuation year; see how much the balance sheet item – in this case accounts payable – has built up. Then you can compute the terminal value and simulate the calculation where the accounts payable are treated like debt in the bridge between enterprise value and equity value. To simulate a valuation that begins in year six (the year after the valuation year) and ends in year nine (per the assumed four year explicit period), you can do the following:

1. Construct switch variables for the valuation year, the explicit period (using the AND function) and the terminal period as documented in Part 1.

2. Compute the accounts payable balance using an opening balance, adding the amounts created from the delaying expenses in the current year and subtracting amounts paid in the prior year. Also compute the EBITDA that is defined as the cash flow (CF).

3. Compute the explicit period cash flow with an IF statement in a similar manner as above so that the valuation will be as of year five and years prior to the valuation year will contain a value of FALSE. Then compute the value of the explicit period cash flows using the NPV formula.

4. Compute the terminal value using the growth rate formula CF x (1+g)/(WACC-g) and multiply the result by the terminal value switch. To assure that the value will be computed as of the valuation year, also use an IF statement using the explicit year switch as demonstrated below. Then compute the present value of the terminal value using the NPV function.

   Terminal Value = IF(Explicit Switch, CF x (1+g/(WACC-g) * Terminal Switch)

5. Sum the NPV of the explicit cash flows and the NPV of the terminal cash flow to establish the enterprise value. Then subtract the closing balance of the accounts payable to compute the equity value and compare this value to the true value of the equity cash flows using the long-term model.

| Valuation assuming A/P is Debt | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Explicit Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | FALSE |
| Terminal Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE |
| Valuation Period | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE | FALSE | FALSE | FALSE |
| | | | | | | | | | | | | |
| A/P Balance | | | | | | | | | | | | |
| Opening Balance | | 0.00 | 38.36 | 40.27 | 42.29 | 44.40 | 46.62 | 48.95 | 51.40 | 53.97 | 56.67 | 59.50 |
| Add: Amounts Generated | | 38.36 | 40.27 | 42.29 | 44.40 | 46.62 | 48.95 | 51.40 | 53.97 | 56.67 | 59.50 | 62.48 |
| Less: Amounts Re-paid | | 0.00 | 38.36 | 40.27 | 42.29 | 44.40 | 46.62 | 48.95 | 51.40 | 53.97 | 56.67 | 59.50 |
| Closing Balance | | 38.36 | 40.27 | 42.29 | 44.40 | 46.62 | 48.95 | 51.40 | 53.97 | 56.67 | 59.50 | 62.48 |
| | | | | | | | | | | | | |
| EBITDA | | 60.00 | 63.00 | 66.15 | 69.46 | 72.93 | 76.58 | 80.41 | 84.43 | 88.65 | 93.08 | 97.73 |
| EBITDA in Explicit Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 80.41 | 84.43 | 88.65 | 93.08 | FALSE |
| PV of EBITDA | 273.05 | | | | | | | | | | | |
| Terminal Value | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 0.00 | 0.00 | 0.00 | 1,954.67 | FALSE |
| Enterprise Value | 1,335.07 | | | | | | | | | | | |
| Less: A/P Classified as Debt | 48.95 | | | | | | | | | | | |
| Net Equity Value | 1,286.12 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Value Difference | 370.95 | | | | | | | | | | | |

The above analysis demonstrates that if accounts payable were to be treated as debt, the value of the company would be understated relative to the true amount. This comes about because (1) accounts payable are subtracted from the enterprise value even they do not come due and (2) the EBITDA does not include reflect true cash flow whereby cash outflows are reduced because of the continuing delay in payment of bills. When correcting these two elements and re-computing the value using the technique shown above with the explicit period and terminal period cash flow, the value is exactly the same as the true long-term amount as shown in the excerpt below. This may seem like a lot of work to prove something that you already knew, but the process of making the proof is important thing. If you are making valuations using EV/EBITDA or applying the discounted cash flow model, you will probably at some time have debates about which items should be included in the bridge. Hopefully, the idea of creating a long-term analysis and then establishing a balance sheet from growth rate assumptions can help you resolve the arguments.

| Valuation with Working Capital Treatment | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Explicit Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE |
| Terminal Period | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE |
| Valuation Period | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| | | | | | | | | | | | | | |
| EBITDA | | 60.00 | 63.00 | 66.15 | 69.46 | 72.93 | 76.58 | 80.41 | 84.43 | 88.65 | 93.08 | 97.73 | 102.62 |
| Working Capital Changes | | -38.36 | -1.92 | -2.01 | -2.11 | -2.22 | -2.33 | -2.45 | -2.57 | -2.70 | -2.83 | -2.98 | -3.12 |
| Free Cash Flow | | 98.36 | 64.92 | 68.16 | 71.57 | 75.15 | 78.91 | 82.85 | 87.00 | 91.35 | 95.91 | 100.71 | 105.74 |
| | NPV | | | | | | | | | | | | |
| Free Cash Flow in Explicit Period | 281.36 | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 82.85 | 87.00 | 91.35 | 95.91 | FALSE | FALSE |
| Terminal Value | 1,375.71 | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 0.00 | 0.00 | 0.00 | 2,014.18 | FALSE | FALSE |
| Total Enterpise and Equity Value | 1,657.07 | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| True Value | 1,657.07 | | | | | | | | | | | | |

# Chapter 25: Items in the Invested Capital Segregation that Force you to think about Cash Flow, Accounting and Cost of Capital Issued

Many balance sheet items can be simulated with type of process used above for accounts payable and have an unambiguous classification in terms of invested capital and enterprise value. Unfortunately, the answer for other balance sheet items in terms of classification is sometimes “it depends.” Items discussed in this chapter that are more ambiguous than accounts payable include accumulated deferred taxes, operating cash and derivative assets and liabilities. The treatment of these and other items can only be resolved by understanding the accounting and on-going cash flow implications of the items. A further issue related to classification of assets is the treatment of different items is the weighted average cost of capital calculation.

## Deferred Taxes from Depreciation are Associated with Operations and Generally Should not be Treated as Invested Capital Just like Accounts Payable

Accumulated deferred taxes may be the most common source of error when segregating balance sheet items between those related to generation of EBITDA and those related to costs and income that are not part of EBITDA. Accumulated deferred taxes are often recorded as a liability on the balance sheet representing the amount of taxes that has not yet been paid relative to the amount of taxes that has been recorded on the profit and loss statement. The general idea behind deferred tax is that taxes paid have been reduced on a temporary basis and over the lifetime of assets on the balance sheet, the taxes paid will eventually be more than the taxes on the books as the beneficial tax deductions which are temporary in nature expire. The most typical example is that of book and tax depreciation where the tax depreciation rate is greater than the book depreciation in early years of the life of an asset. In computing book income taxes in NOPLAT; calculating book tax on the income statement; and, in the calculation of free cash flow, book depreciation and intangible amortization is used rather than tax depreciation. Actual cash taxes paid by a company that drive value are a function of tax depreciation and allowable amortization allowable for tax purposes.

The accounting and cash flow treatment of deferred taxes is supposed to recognise that future tax will increase when the accelerated depreciation become less than book depreciation. The idea of deferred taxes reversing is illustrated on the simple example below where an asset has a four year book life and a two year tax life.

| | | | | | |
|---|---|---|---|---|---|
| **Assumptions** | | | | | |
| Book Life | 4 | | | | |
| Tax Life | 2 | | | | |
| | | | | | |
| Tax Rate | 40% | | | | |
| Capital Expenditures | 100,000 | | | | |
| | | | | | |
| **Book and Tax Depreciation** | | | | | |
| Year | | 1 | 2 | 3 | 4 |
| | | | | | |
| Book Depreciation | | 25,000.00 | 25,000.00 | 25,000.00 | 25,000.00 |
| Tax Depreciation | | 50,000.00 | 50,000.00 | - | - |
| Tax - Book Depreciation | | 25,000.00 | 25,000.00 | (25,000.00) | (25,000.00) |
| (Tax - Book) x Tax Rate | | 10,000.00 | 10,000.00 | (10,000.00) | (10,000.00) |
| | | | | | |
| **Accumulated Deferred Taxes** | | | | | |
| Opening Balance | | - | 10,000.00 | 20,000.00 | 10,000.00 |
| Add: Deferred Tax Change | | 10,000.00 | 10,000.00 | (10,000.00) | (10,000.00) |
| Closing Balance | - | 10,000.00 | 20,000.00 | 10,000.00 | - |

The problem with the simple example above is that as capital expenditures are made, tax depreciation keeps increasing and it is continually more than book depreciation. Indeed, after a cycle of plant in which after retirements begin, the changes in deferred tax stabilize to a fixed level relative to capital expenditures if the growth rate in capital expenditures is constant. As capital expenditures continue, the deferred tax liability never comes due and the deferred tax liability continues to increase.

If deferred taxes really cause equity investors to have to incur future cash outflows that are not already deducted as part of free cash flow, then the value of the accumulated deferred tax liability should be deducted from enterprise value. However, when a company is continually making capital expenditures, the negative future cash flows are never incurred. Here, as was the case with accounts payable, a new larger cash inflow from a new liability continually replaces the earlier liability. Further, as is the case with accounts payable, there are no interest expenses below the EBITDA line that are associated with the liability. Thus when segregating deferred taxes for purposes of computing invested capital and enterprise value the treatment for deferred taxes associated with capital expenditures (such as accelerated depreciation) should be treated as a positive part of free cash flow and not included as an obligation of equity holders. Therefore, the cash flow should be computed using the formula:

Free Cash Flow = EBITDA – Capital Expenditures – Working Capital Changes + Deferred Tax Changes

When computing invested capital, accumulated deferred taxes should generally be on the direct side of the ledger (along with net plant, working capital and other items that support EBITDA) rather than items such debt and surplus cash that are on the net financing part of the ledger. This is because the deferred taxes that can in part finance an investment are not contributed by investors. Assume that two companies are identical in every respect except that one company is able to use accelerated depreciation and the second is cannot. The company that uses deferred taxes has a cost advantage vis a vis the other company should have higher value and a higher return on invested capital. In the case of deferred tax assets generated from a tax carryforward, the situation is again more complex. Here, one can imagine that the company has made an investment in the deferred tax assets and will receive the return when the carryforward is used. This deferred tax asset related to the carryforward does not generate NOPLAT (as the taxes are derived from book income) and one could imagine that the asset could be liquidated (in the way a pension surplus could be liquidated). These arguments suggest that accumulated deferred taxes associated with carryforwards should be on the financing side of the ledger.

A second example of deferred tax is the case of net operating loss carryforwards. When the carryforward is created in periods of negative income, taxes recorded on the books are negative and the actual taxes paid are zero. In later periods when the income is positive, the carryforward is used and additional cash flow relative to income occurs. In this case the accumulated deferred tax is an asset on the balance sheet as taxes paid of zero are more than negative tax recorded on the profit and loss statement. In a sense deferred taxes associated with the carryforward is kind of like making an investment when the carryforward is created and then receiving a return on the investment when the carryforward is used. The classification of deferred taxes associated with carryforwards is more complicated than the case of accumulated deferred taxes that arise from accumulated depreciation. In the case of tax carryforwards, if the cash flow from the explicit period encompasses the full period until the extinguishment of the carryforward, then that cash flow should be included in EBITDA and no adjustment should be in the terminal value. On the other hand, if the explicit period ends when the carryforward is generating cash flow (because the taxes paid are less than they would be if the earlier losses had not occurred) then there is some value of the carryforward that continues after the terminal period. This value cannot be measured by simply assuming the cash flow continues and grows using the standard growth formula. In theory, the only way to measure the cash flow associated with an expiring tax loss carryforward is to directly estimate the cash flows and then to discount those cash flows at the cost of capital.

## The Tricky Issue of Operating Cash that Produces Interest Income Below the EBITDA Line and Also is an Asset Used in Business Operations

In terms of surplus cash and other investments that are not necessary for operating the business, the treatment for the invested capital calculation is fairly clear. On the other hand, appropriate classification of cash needed to operate the business is more complex. In the case of surplus cash, income is recorded as interest income below the EBITDA line and the surplus cash is not an asset that is necessary to produce EBITDA. Therefore, when computing amounts of financing required to generate EBTDA, if some of the debt and equity financing has been used to finance surplus cash instead of assets that generate EBITDA, this amount should be deducted from the total capital on the balance sheet. For operating cash, you could make the argument that it is like surplus cash as it generates income below the EBITDA line. You could also make the argument that operating cash is like accounts receivable where the investment is necessary to generate EBITDA -- when a company needs more operating cash it will have to increase invested capital and ultimately realise higher revenues to compensate for the investment. If operating cash (sometimes measured as two percent of revenues) is considered as a financing item, the equity value is increased relative to the enterprise value while if the operating cash is considered as a necessary asset for running the business, then free cash flow is lower and the equity value is reduced. Using the two percent rule of thumb, this swing could be four percent of the equity value of a company.

It is often taken for granted that operating cash should be differentiated from surplus cash (at least in theory), this issue is not quite so obvious.  The idea behind accounting for operating cash in a similar manner to accounts receivable is that some level of operating cash is necessary to run the business and that free cash flow could not be generated without the operating cash.  However, a counter argument can be made that operating cash is a by-product of operating a company and it provides value to equity.  The argument that cash is necessary to generate the EBITDA is not much different than saying an overdraft short-term debt facility is necessary to run the business.  It would be standard practice to deduct borrowings from the overdraft facility from the enterprise value.  The argument that cash is necessary to generate the EBITDA is not much different than saying an overdraft short-term debt facility is necessary to run the business.  It would be standard practice to deduct borrowings from the overdraft facility from the enterprise value.

Part of the confusion in classification of operating cash in part comes from the effect of cash on the weighted average cost of capital and the lower return that is earned on cash relative to other investments. The issue of how to treat operating cash can be in part resolved by considering a silly company that does nothing but take investor's money and then re-invests that money in treasury bills.  This company can be used for resolving various arguments because there is no ambiguity with respect to the cost of capital.  If the company is growing fast and requires a lot of operating cash to run the business, but then invests this surplus cash in the same treasury bills, the operating cash has no cost for investors.  If the enterprise value is defined as the present value of the income from the treasury bills not including the operating cash, then the added treasury bills from operating cash should clearly be added to the enterprise value.  The issue is more confusing when a more realistic example is used.  If the weighted cost of capital does not include operating cash (see the discussion below about adjusting beta for net debt), then cash reduces the cost of capital and provides income implying it should increase equity value.  If the weighted cost of capital without the effect of operating cash is applied to free cash flow (reducing the value of free cash flow) is applied, then the operating cash should be added in a similar manner to the treasury bill example.

The treatment of operating cash can be resolved with the type of long-term proof demonstrated in the last chapter.  If the cost of capital on the operating cash is independent of the operating cash implying that the cost of capital is higher than it would be if operating cash were included in the measuring the volatility of cash flow, then operating cash should be treated in the same way as surplus cash.  In this calculation, the free cash flow has a lower value that it would have had were the low risk operating cash were included in the weighted average calculation.  The value of the operating cash is then separated from the operating cash and it includes cash outflows required to run the business as well as interest income.  If the cash flow is valued at the interest income rate for the cash flow, then value is the amount on the balance sheet.  All of this implies that the correct treatment is to take operating cash out of both the free cash flow and the weighted average cost of capital. Once this is done, the operating cash can be added to the enterprise value in the same way as surplus cash.

The relationship between measurement of the weighted cost of capital and treatment of operating cash is demonstrated by the process of de-levering and re-levering the beta.  The net debt rather than the gross debt is often used when computing the unlevered beta and cost of capital as illustrated in the excerpt below.  If the cash lowers the amount of debt, the implicit cost of capital and the un-levered beta increase. For example, if companies like Apple and Microsoft are part of a sample and they each have a lot of cash on their balance sheet, the measured equity beta of each company understates the risk associated with free cash flow.  If net debt is used in adjusting the cost of capital then the cost of capital increases and reflects the volatility associated with the underlying EBITDA.  If the operating cash is used as well as the surplus cash then the treatment discussed above where operating cash flow is treated the same as surplus cash flow is correct.

## WACC Analysis

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| Company | Levered (1) Beta $B_L$ | Net Debt | D/E | % Debt | Effective Tax Rate | Unlevered Beta $B_U$ |
|---|---|---|---|---|---|---|
| ITC Holdings Corp. | 0.92 | $2,264 | 0.97 | 49.2% | 38.1% | 0.58 |
| Cleco Corporation | 0.75 | 1,161 | 0.81 | 44.8% | 15.3% | 0.44 |
| UniSource Energy Corporation | 0.77 | 1,838 | 1.87 | 65.1% | 55.0% | 0.42 |
| ALLETE, Inc. | 0.76 | 559 | 0.56 | 36.0% | 34.3% | 0.55 |
| NorthWestern Corporation | 0.82 | 855 | 0.98 | 49.4% | 37.3% | 0.51 |
| MGE Energy, Inc. | 0.71 | 365 | 0.43 | 30.3% | 35.5% | 0.55 |
| CH Energy Group, Inc. | 0.79 | 453 | 0.58 | 36.5% | 37.6% | 0.58 |
| UIL Holdings Corporation | 0.88 | 764 | 1.05 | 51.1% | 41.8% | 0.55 |
| El Paso Electric Company | 0.79 | 740 | 1.09 | 52.1% | 32.8% | 0.46 |
| Empire District Electric Company | 0.77 | 746 | 1.17 | 54.0% | 32.5% | 0.43 |
| Unitil Corporation | 0.54 | 325 | 1.45 | 59.1% | 32.0% | 0.27 |
| Central Vermont Public Service Corporation | 0.74 | 176 | 0.80 | 44.4% | 39.6% | 0.50 |
| Florida Public Utilities Company | 0.73 | 49 | 0.56 | 36.0% | 35.0% | 0.53 |
| **Average** | **0.77** | | **0.95** | **46.8%** | **35.9%** | **0.49** |

| Cost of Equity Build Up | |
|---|---|
| Unlevered Beta | 0.49 |
| Levered Beta | 0.65 |
| Risk Free Rate (Rf) (2) | 3.6% |
| Market Risk Premium | 5.0% |
| **Cost of Equity** | **6.9%** |

| Assumed Target Capital Structure % (4) | | Pre-Tax Cost | After-Tax Cost | WACC Build-Up |
|---|---|---|---|---|
| Net Debt | 32.4% | 5.6% | 3.9% | 1.3% |
| Equity at Market Value | 67.6% | 6.9% | 6.9% | 4.6% |
| **Total** | 100.0% | | | |
| **Weighted Average Cost of Capital (WACC)** | | | | **5.9%** |

| Inputs | |
|---|---|
| Date | 07/30/09 |
| Beta Update | 07/31/09 |
| Debt Rates | 07/30/09 |
| t = Tax Rate | 30.9% |
| MRP = Market Risk Premium | 5.0% |
| Risk Free Rate | 3.6% |
| Assumed Credit Spread | 2.0% |

WACC Sensitivity

| Beta | % Debt | | | | |
|---|---|---|---|---|---|
| | 20.0% | 27.4% | 32.4% | 37.4% | 40.0% |
| 0.39 | 5.5% | 5.5% | 5.5% | 5.4% | 5.4% |
| 0.44 | 5.7% | 5.7% | 5.7% | 5.7% | 5.6% |
| **0.49** | 6.0% | 5.9% | 5.9% | 5.9% | 5.9% |
| 0.54 | 6.2% | 6.2% | 6.1% | 6.1% | 6.1% |
| 0.59 | 6.4% | 6.4% | 6.4% | 6.3% | 6.3% |

Formulas

Levered Beta ($B_L$)= Unlevered Beta ($B_U$) * (1+ D / E) * (1 - t)
Unlevered Beta ($B_U$)= Levered Beta ($B_L$) / (1+ D / E) * (1 - t)
Cost of Equity (Re) = Rf + Beta * MRP
WACC = ((D / (D + E) * Rd * (1 - t)) + (E / (D + E) * Re
Adjusted Beta = Unadjusted Beta * 0.67 + 1 * 0.33

In cases where debt is part of the capital structure, debt reduces the un-levered or asset beta as in the example above -- the observed equity beta is .95 while the asset beta is .49. For the single company being valued, re-levering with additional debt increases the equity beta and then reduces the cost of capital given the increased beta. Without taxes, these two effects would offset each other and the asset beta would drive the cost of capital. If there is surplus and operating cash instead of debt, the opposite occurs. Operating and surplus cash increases the asset beta relative to the observed equity beta and without taxes this increased asset beta is the risk driver of the cost of capital. This is principle of the proof in the prior paragraph. The free cash flow is computed independent of the effects of the operating cash and the cash is valued separately. Therefore, if the weighted average cost of capital is adjusted appropriately through adjusting the asset beta for both operating and surplus cash, the operating cash should be treated like surplus cash and not in analogous manner to accounts receivable.

The idea of isolating the cost of capital associated with operating cash flow does not only apply to operating and surplus cash. If a company has associated investments that are much more risky than the assets that create EBITDA, then the cost of capital applied to free cash flow should remove the effects of these risky investments. This is accomplished by removing the associated investments from the asset beta of comparable companies as operating cash was removed from the calculation. Similarly, if a company is financing itself with unfunded pensions instead of debt, the asset beta should be adjusted for this form of equivalent debt. You should be able to see the pattern. Every item that is classified on the financing side of the invested capital ledger should also be part of the process of adjusting the asset beta. The process of segregating the balance sheet for purposes of invested capital not only drives the return on investment, it also affects the enterprise value to equity value bridge and the weighted average cost capital.

### Treatment of Derivative Assets and Liabilities Depends on How the Derivatives Affect EBITDA and Free Cash Flow

The fair value of derivative liabilities and assets recorded on the balance sheet must either be classified on the finance side or the net asset side of the invested capital ledger like any other asset or liability. A few years ago the value of derivative assets or liabilities such as swaps, options and forward contracts were not valued in financial statements before settlement of the contracts. These days the market value of derivatives is put on the balance sheet even though it did not arise from a cash outflow made by investors. To understand how derivatives should be treated in the invested capital calculation and in the bridge between enterprise value and equity value a minimal amount of accounting should be understood as was the case for deferred taxes. Derivatives can be accounted for using hedge treatment or fair value treatment. Derivatives that are classified as hedges do not have an effect on income until the contract is settled while derivatives under the fair value treatment affect profit any time the value changes. To illustrate the accounting and valuation effects of a derivative one can consider two simple cases. The first case is a futures contract that fixes the price of oil for an exploration company. Assume that the price is fixed at 150 while the current price of oil is 100 implying that the contract has a positive value. The second case is an interest rate swap that fixes interest rates at 4% in three years. In this case assume the current interest rate is 2% implying that the swap has a negative value and is classified as a liability. If hedge accounting is used for the oil futures contract, revenue and EBITDA is not recognised until the oil exploration company settles the contract in three years. For the intervening years, the value appears on the balance sheet as an asset and an account called accumulated other comprehensive income is also increased. If the company uses fair value treatment for the oil price forward contract, the EBITDA is increased when the value of the contract changes (in the current year), rather than when the contract is settled in three years. With the fair value treatment, accumulated other comprehensive income does not change when the value changes because equity is changed when profit changes. The same sort of treatment could occur for the interest rate swap, but there would be a liability instead of an asset and the loss would be below the EBITDA line in either the first year or the third year. The difference in accounting treatment affects the timing of income, but either way the change in the value of the derivative eventually shows up in profit.

Unlike other balance sheet items, the treatment of derivatives may differ for purposes of computing invested capital and for purposes of evaluating the bridge between enterprise value and equity value. Recall from the very beginning of the discussion of ROE and ROIC that invested capital is supposed to represent the amount of money that investors initially put into the business in order to generate EBITDA. For derivatives that are accounted for either using the hedge treatment or the fair value treatment, the balance sheet value does not represent investment that has been made by investors. Instead, the balance sheet value measures the change in the market value of the derivative over time. If the invested capital is to be measured, then the value of the derivatives should be removed from equity value and the derivatives should be put on the financing side of the ledger as they do not represent money that has been spent to generate EBITDA. Note that using this logic, any impairment or asset write-up should also be adjusted for purposes of computing invested capital.

The reason for not including derivatives on the net asset side of the ledger can demonstrated by thinking of the derivatives as taking a bet. If the company has made a good bet, then the ROIC increases. If the company has made a bad bet, the ROIC declines. Differences in the ROIC due to the accounting treatment of derivatives are simply a matter of timing. When the bet was originally made, there was no investment required to enable the bet. The denominator of the ROIC should not be affected by changes in the value of the derivative. The implication of all of this is that the equity balance on the balance sheet should be adjusted for the value of the derivative when either the ROE or the ROIC is computed.

Unlike classification of all of the other items discussed above, the classification of derivatives can be different for purposes of evaluating the bridge between enterprise value and equity value than in classifying invested capital. This is because the market value of derivatives can be used to compute the difference between the market value and the book value of items on the balance sheet. The general rule for classifying derivatives when computing the bridge between equity value and equity value is simple. If settlement of the derivative is already reflected in EBITDA and free cash flow, the value of the derivative is already in the enterprise value and including it again in the bridge between equity value and enterprise value would be double counting the item. On the other hand, if the derivative has not been valued as part of EBITDA and free cash flow, it should be part of the bridge. To demonstrate this idea return to the example of the oil forward contract and the interest rate swap introduced at the beginning of this section. If the 150 oil price from the forward contract is included in the projection of EBITDA, then the value of the derivative is already in the discounted free cash flow value. In the case of the interest rate swap, if debt is taken from the balance sheet, the value of the swap can be used to move the debt from book value to market value and the derivative should be included as part of the value of the debt rather than left out of the analysis. Similar arguments can be used for exchange rate hedges. As the WACC should use debt and equity market value, the derivatives that are included in the bridge between equity value and enterprise value should also be included in the WACC table.

### Reconciliation of Invested Capital Items and Taking Confusion Treatment of Derivative Assets and Liabilities Depends on How the Derivatives Affect EBITDA and Free Cash Flow

Through application of the consistent principle that cash flows not included in EBITDA, free cash flow and enterprise value, the market value of debt has similar characteristics to the other items above. The cost of capital associated with the market value of the debt should be measured at the date of the debt valuation and be measured in the WACC so that the cost of capital associated with the enterprise value is not distorted. This means that if one believes in computing asset betas and then re-levering the betas (which is demonstrated to be inaccurate below) that the re-levered beta must be consistent with the market value of the net debt at the valuation date. For example, it is inappropriate to use a target debt to capital ratio that is inconsistent with the net debt used in the equity to enterprise value bridge. If for example, the debt actual value of the debt results in a debt to capital ratio of 70%, but the target debt to capital ratio is 40%, the valuation would be distorted through use of the target capital structure in the WACC and the re-levered beta, but use of the actual market value of debt in the bridge. The problem of inconsistent valuation is illustrated in the example below.

| Distortions from Target Capital Structure | | |
|---|---|---|
| **Assumptions** | | |
| Unlevered Beta | 0.8 | |
| Target Debt to Capital | 40% | |
| Actual Market Value of Debt to Capital | 70% | |
| Risk Free Rate | 4.50% | |
| Equity Market Risk Premium | 5.00% | |
| | | |
| **Computed Cost of Capital** | | |
| Cost of Equity Using Target Debt to Capital | 11.17% | |
| Cost of Equity Using Measured Debt to Capital | 17.83% | |
| Theoretical WACC using Asset Beta | 8.50% | |
| | | |
| **Current Values** | | |
| Equity Value | 2,000.00 | 30% |
| Market Value of Debt | 4,666.67 | 70% |
| Total Market Value of Enterprise | 6,666.67 | |
| | | |
| **Contining Cash Flow** | | |
| Assumed Perpetual Cash Flow | 566.67 | |
| Perpetual Debt Service at Risk Free Rate | 210.00 | |
| Perpetual Equity Cash Flow | 356.67 | |
| | | |
| **Implied Valuations** | | |
| Value of Equity using Acutal Debt Ratio | 2,000.00 | |
| Value of Equity using Target Debt to Capital | 3,194.03 | |
| | | |
| Enterprise Value | 6,666.67 | |
| Less: Market Value of Debt | 4,666.67 | |
| Value of Equity | 2,000.00 | |

## Items that Have Little or No Value on the Balance Sheet that Should be Included in the Bridge between Equity Value and Enterprise Value

When discussing the discounted cash flow model, finance texts often describe the example of land that is held for building a future factory or a real estate development as something that should be included in the bridge between enterprise value and equity value. If the land is not currently earning income, but could be sold at a substantial sum, the additional amount should be included in the bridge between enterprise value and equity value. For example, suppose a parcel of land is currently earning nominal amounts for being used as farmland but that the land will be used in five years for development of a large commercial building. If the farm income is included in the free cash flow, then difference between the value that the land could be sold for and the present value of the farm land should be included in the bridge. If one takes this example to the extreme – say a hotel company buys land all over the world that may or may not be used in developing hotels, then the beta of the company should incorporate the risks associated with land speculation and the value of the land should be included as an element in the weighted average cost of capital calculation with a high beta. This adjustment to the WACC would probably never really be made, but it illustrates how to think through the problem. Because this example is used by textbooks it sometimes causes confusion in practical applications. For instance the value of land upon which a factory sits may could be argued to be an additional item that should be included in the bridge between equity value and enterprise value. Unless the factory is planned to be sold in a short period and the cash flow from the sale is not included in the flow, this adjustment is generally not appropriate.

Investments in land and discontinued assets that are not producing EBITDA should be deducted from the invested capital at the investment cost because debt and equity raised to finance these items does not generate EBITDA. The case of Apple Computers demonstrates both the idea of allocating items on the basis of the EBITDA line and the general concept of ROIC relative to ROE. In 2013 Apple had more than 100 billion of cash and long-term investments on it balance sheet, but the cash only generated about 1% in income. Apple's return on equity of about 34% is strongly affected by the cash on the balance sheet. If the cash is removed from the invested capital, then the return on investment that Apple is earning on its non-financial assets is about 65%. So if you are buying your I-phone and wondering about how much money you are generating for Apple investors, the measure of 65% tells you a lot more than the 34%.

# Chapter 26: Four General Terminal Value Methods and Debates Involving Making Truly Independent Valuation versus Relative Valuations that Directly or Indirectly Depend on Valuations Made By Other People

Using the discounted cash flow model to value a corporation is the culmination of a series of finance theories encompassing Modigliani and Miller, the Capital Asset Pricing Model and notion that companies with an indefinite life eventually reach some kind of stable equilibrium. In theory, a DCF analysis should be made from reflecting the fundamental factors that drive the value of a company including return on capital, cost of capital and growth rates. It is considered the central valuation approach by academics and, in its pure form, the DCF valuation approach is not dependent on the opinions of other analysts. The primary alternative valuation approach to the DCF model applies multiples such as the P/E ratio and EV/EBITDA to current or projected income. Using multiples is sometimes called relative valuation because, in contrast to the DCF model, is dependent on the judgements of others in making a valuation. Multiples depend on how the market implicitly considers cost of capital and growth.

In spite of the theoretical advantages of the DCF model in its pure form (i.e. without using multiples in the terminal value), is fraught with both practical and theoretical difficulties. Problems in computing the cost of capital include the accuracy of beta in measuring risk and difficulties in assessing the equity market risk premium. These cost of capital problems can translate into such wide ranges of valuation when applying the discounted cash flow model that the whole process can become all but useless in practical situations. Difficulties in measuring the cost of capital are compounded by required assumptions with respect to the date at which a company will reach some kind of mythical equilibrium and begin to grow in slow and smooth manner. Finally, applying growth rates in the terminal value formula without being very careful about adjustments to depreciation expense, working capital changes, capital expenditures and deferred tax can lead to biased valuations.

Perhaps the biggest practical problem with the DCF method is that there is a high dependence in the discounted cash flow model on WACC to compute the present value of cash flows and the assumed growth rate in and/or the multiples applied to projected earnings. It is well known to practitioners that computing the discounted value of free cash flow is subject to a lot of bias and manipulation. All one has to do is ask somebody who has made a valuation analysis using the discounted cash flow technique to see how much the results can be fudged through tinkering a bit with the terminal growth, the discount rate or one of the assumptions. An illustration of the classic DCF problem is shown in extract below from a sell side stock analyst presentation. In the second table, the WACC only changes from 5.7% to 6.3% -- a very small variation given all of the problems and uncertainties associated with the capital asset pricing model. Further, the terminal growth rate varies between 2.5% and 3.1% which again is a very small variation considering all of the unknowns about the future state of the economy, future inflation and other company specific factors. Given this small variation in the cost of capital and the growth rates, the value of the stock varies from a low of 31.96 to a high of 65.43 or a range of more than 100%. This variation in valuation that results from small changes in variables – WACC and growth -- that are extremely difficult to assess renders the model useless even if the model faithfully applies all of the financial theories.

## Valuation

We always find the greatest challenge with the ITC story coming from valuation, largely because there is no good comp group for the stock. Accordingly, we focus our efforts predominately on DCF valuation to take into account the large capital spending program over coming years and higher level of free cash generation at the end of the capital investment cycle. Exhibits 4 and 5 look at implied fair values for ITC under different discount rate and terminal value assumptions. Using the two methodologies (terminal multiple and perpetual growth), we are comfortable with a $46 fair value for the stock before taking into account the incremental value drivers identified in Exhibit 1.

Exhibit 4: **DCF Valuation: Terminal Multiple**

| Terminal EBITDA Multiple | Discount Rate: 5.70% | 5.80% | 5.90% | 6.00% | 6.10% | 6.20% | 6.30% |
|---|---|---|---|---|---|---|---|
| 9.25x | 43.82 | 42.87 | 41.94 | 41.02 | 40.11 | 39.22 | 38.33 |
| 9.50x | 45.64 | 44.67 | 43.72 | 42.78 | 41.85 | 40.93 | 40.03 |
| 9.75x | 47.46 | 46.47 | 45.49 | 44.53 | 43.58 | 42.64 | 41.72 |
| 10.00x | 49.28 | 48.27 | 47.27 | 46.28 | 45.31 | 44.35 | 43.41 |
| 10.25x | 51.10 | 50.07 | 49.05 | 48.04 | 47.05 | 46.07 | 45.10 |
| 10.50x | 52.92 | 51.86 | 50.82 | 49.79 | 48.78 | 47.78 | 46.79 |
| 10.75x | 54.74 | 53.66 | 52.60 | 51.55 | 50.51 | 49.49 | 48.48 |

*Source: Company data, Credit Suisse estimates*

Exhibit 5: **DCF Valuation: Perpetual Growth**

| Terminal Growth Rate | Discount Rate: 5.70% | 5.80% | 5.90% | 6.00% | 6.10% | 6.20% | 6.30% |
|---|---|---|---|---|---|---|---|
| 2.50% | 48.33 | 45.18 | 42.22 | 39.43 | 36.80 | 34.33 | 31.98 |
| 2.60% | 50.72 | 47.40 | 44.28 | 41.36 | 38.60 | 36.01 | 33.56 |
| 2.70% | 53.27 | 49.76 | 46.48 | 43.40 | 40.51 | 37.79 | 35.22 |
| 2.80% | 55.99 | 52.28 | 48.81 | 45.57 | 42.53 | 39.67 | 36.98 |
| 2.90% | 58.91 | 54.98 | 51.31 | 47.88 | 44.67 | 41.67 | 38.84 |
| 3.00% | 62.05 | 57.86 | 53.97 | 50.35 | 46.96 | 43.79 | 40.82 |
| 3.10% | 65.43 | 60.97 | 56.83 | 52.98 | 49.40 | 46.05 | 42.92 |

*Source: Company data, Credit Suisse estimates*

The reason for such wide value differences in the above table is entirely due to the manner in which terminal value is computed using the formula:

$$\text{Terminal Value} = [\text{Stable Cash Flow} \times (1+g)/(WACC-g)]/(1+WACC)^{\text{number of periods}}$$

This formula uses WACC in two places, both in computing the terminal value in the last period in discounting the value to the present. To understand problems and alternatives when applying the DCF model, four alternative approaches to the terminal value can be compared below. These methods include the stable growth method discussed above; using a pre-determined EV/EBITDA multiple to apply to EBITDA in the terminal year; applying the value driver formula (1-g/ROIC)/(WACC-g) in the terminal year; or using a multiple that accounts for ROIC, WACC, growth in a regression analysis. Before describing some of the important mechanical modelling details that apply to all of these methods, some of the benefits and the problems are discussed below.

### Method 1: Stable Growth Method

Application of a stable growth formula above that uses a stable cash flow estimate along with a constant growth rate assuming the cash flow grows in perpetuity as illustrated by the formula above. Advantages of the constant growth method are that it does not depend on the valuation made by others (i.e. it is not relative valuation) and it can be applied with a simple formula. Disadvantages are that it does not account for changes in cash flow that arise from changes in rate of return and that it results in a very wide range of results as illustrated above.

This formula is derived from the basic idea that a cash flow in perpetuity can be computed as:

$$\text{Value} = \text{Cash Flow}_1 / \text{Cost of Capital}$$

Since the growth rate applied to cash flow is the reverse of discounting and the cash flow in the next period is the current period multiplied by one plus the growth rate, the formula is the same as assuming the cash flow continually grows and the risk of the cash flow does not change. Because the WACC is in the denominator of the formula, the terminal value changes by a wide margin when the WACC varies. The formula is also very sensitive to the growth rate as a high growth rate can make the denominator very small and imply a high value.

The growth formula can be easily be translated into the EV/EBITDA ratio as the terminal value is the enterprise value and the free cash flow is a function of the EBITDA. The formula below demonstrates that all of the four different terminal value techniques can be reconciled.

$$\text{TV} = \text{FCFF}/(\text{WACC-g}) = (\text{EBITDA} – \text{Cap Expenditure} – \text{WC Change} – \text{Tax})/(\text{WACC-g})$$

While questionable logic (such as assuming world economic growth will stop) and errors in the prediction of growth are pervasive in valuation, the errors in valuation analysis discussed here are not related to under-estimating or over-estimating growth. Precisely because the exercise of predicting growth is so difficult, it would be presumptuous to assert that valuation analyses were flawed when someone made an optimistic or pessimistic estimate. However, the relationship between growth and cost of capital is worthy of mention. Growth rate uncertainty is a big part of the reason that cash flows themselves are uncertain and companies where valuations depend on high growth should have high cost of capital no matter what the CAPM suggests. Given the inherent uncertainty of guessing at what date growth rates will change, investments that do not depend on achieving high growth for a long time period should be valued more highly than investment strategies which cannot easily adjust to changes in growth.

One of the big challenges in applying the constant growth method is determining the stable cash flow that should be used when the growth rate changes. A basic and simple idea that surprisingly is not applied much is that capital expenditures and working capital investment are necessary to support EBITDA. If there is more growth in EBITDA, more capital expenditure and more working capital investment are of course necessary. The next few chapters explain how you can develop assumptions for working capital investment and capital expenditures that are consistent with changing growth rates. Earlier chapters that described computation and presentation of return on invested capital that is so important in judging whether your models are reasonable. In coming up with a reasonable stable cash flow calculation, the following techniques can be applied to each of the components of cash flow:

| | |
|---|---|
| **EBITDA** | Review ROIC in Terminal year and assure that forecasts are reasonable in the context of history and the competitive structure of the industry |
| **Working Capital Investment** | Apply the formula Stable WC Change = WC/EBITDA EBITDA x g/(1+g) |
| **Capital Expenditure** | Develop a user-defined function that computes a stable value of capital expenditures to depreciation that a can be applied to depreciation in the terminal period |

## Method 2: Value Driver Method Including Return Relative to Cost of Capital

In theory, there are only three things that drive the value of any business enterprise. The first is how much money you earn relative to your investment that can be measured by the return on invested capital. The second is the risk of your earnings as measured by the WACC. The third is the growth rate in your investment, the value of which depends on your ability to earn a return above the cost of capital. One can account for both growth and return on capital relative to cost of capital through applying a formula to the NOPLAT as shown below (recall that NOPLAT is EBIT x (1-t)):

Enterprise Value = NOPLAT x (1 – Asset Growth/ROIC)/(WACC – Asset growth)

This formula, which is discussed at length in a subsequent chapter, implies that the value of a company can be computed from the three value drivers -- the growth rate, the cost of capital and the return parameters along with the current level of income.

The formula seems to be a magic in a few dimensions. First, the formula accounts for all of three value drivers instead of only growth and WACC as was the case with the stable growth rate method. Second, the value driver formula does not include capital expenditures or working capital investment so that you do not have to worry about the stable ratios for these items. Third, if the ROIC is assumed to be equal to WACC, then the value is not sensitive to the growth rate. While some analysts argue that this formula is the only way to compute terminal value there are a number of problems with the method that make it not very good. First, while it is easy to plug things into the formula, it is difficult to explain the logic of the different items. Second, implicit assumptions about a company to earn the stable rate of return depend on the growth rate which is not logical. Third, the equation is not mechanically correct when the growth rate changes which is the whole reason that you are applying the formula. These problems are addressed in a separate chapter.

## Method 3: Use of Multiples from Comparative Analysis

When applying the value driver formula, if the return on invested capital is assumed to be different than the WACC, the variation in value resulting from alternative WACC and growth can be almost as much as the variation that results from the stable growth rate method. To reduce the effect of the WACC in DCF analysis one can simply multiply the terminal EBITDA by an assumed EV/EBITDA ratio. The formula for the stable growth includes WACC in two places:

$$\text{Terminal Value} = [\text{Stable Cash Flow x } (1+g)/(\text{WACC}-g)]/(1+\text{WACC})^{\text{number of periods}}$$

If a terminal multiple is used, the WACC is in only one place:

$$\text{Terminal Value} = [\text{EBITDA x EV/EBITDA}]/(1+\text{WACC})^{\text{number of periods}}$$

Comparing the two formulas demonstrates that the second is much less sensitive to the WACC assumption that is so difficult to obtain. To apply this method one can estimate the EV/EBITDA by making some kind of comparative analysis where a reasonable range can be established. If the method is used, one does not have to worry about the stable amount of working capital, capital expenditures or deferred tax.

If the terminal value is computed through multiplying the stable period EBITDA by the EV/EBITDA multiple, it seems that you do not have to worry about stable ratios of working capital to EBITDA or stable ratios of capital expenditure to depreciation. But applying an EV/EBITDA ratio to terminal value has big theoretical problems. The most obvious problems are: (1) the EV/EBTIDA ratio can come from dramatically different implicit assumptions in the market relative to what are in your financial model; and, (2) the EV/EBITDA ratio is often dramatically different in the terminal year when the growth rate declines

than when the EBITDA is expected to grow quickly.  This latter problem is illustrated in the excerpt below where the EV/EBITDA at the valuation date is 22.2x while the ratio at the terminal date after the growth slows is 14.8x.  This example also shows that dramatic variation in valuation from change in the growth rate and changes in the discount rate.

| **Operational Assumptions** | | **Valuation Assumptions** | |
|---|---|---|---|
| EBITDA | 100 | WACC | 9% |
| Acc Payable/EBITDA | 20% | Terminal EV/EBITDA | 10.0x |
| Explicit Period Growth | 10% | WACC / ROIC Spread | 3% |
| Terminal growth | 2% | ROIC | 12% |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Timing*** | | | | | | | | | | | | | | |
| *Year* | | | *2014* | *2015* | *2016* | *2017* | *2018* | *2019* | *2020* | *2021* | *2022* | *2023* | *2024* | *2025* |
| Explicit Period | | | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Terminal Year | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE |
| ***Valuation 2 - Valuation with growth rate*** | | | | | | | | | | | | | | |
| EBITDA | | 100.00 | 110.00 | 121.00 | 133.10 | 146.41 | 161.05 | 177.16 | 194.87 | 214.36 | 235.79 | 259.37 | 285.31 | 313.84 |
| Explicit CFs (including change in acc pa | $1,242.88 | | FALSE | FALSE | FALSE | FALSE | 163.98 | 180.38 | 198.41 | 218.26 | 240.08 | 264.09 | 290.50 | 319.55 |
| Terminal CF(s) | $2,336.83 | | FALSE | FALSE | FALSE | FALSE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4,656.29 |
| Enterprise Value | 3,579.71 | | | | | | | | | | | | | |

| | |
|---|---|
| **Implicit EV/EBITDA - Valuation Date** | **22.2x** |
| **Implicit EV/EBITDA - Terminal Date** | **14.8x** |

| | | Growth | | | | |
|---|---|---|---|---|---|---|
| | | 0% | 1% | 2% | 3% | 4% |
| WACC | 7% | 24.9x | 27.8x | 32.0x | 38.1x | 48.4x |
| | 8% | 21.4x | 23.5x | 26.3x | 30.1x | 35.9x |
| | 9% | 18.8x | 20.3x | 22.2x | 24.8x | 28.4x |
| | 10% | 16.7x | 17.8x | 19.2x | 21.0x | 23.4x |
| | 11% | 14.9x | 15.8x | 16.9x | 18.2x | 19.9x |

## Method 4: Derived Multiple Formula

The final method discussed derives a theoretical EV/EBITDA multiple given explicit assumptions about growth rates, returns and the cost of capital.  It does not magically get rid of having to measure the cost of capital, but it does correct some of the problems with the methods above:

- The derived multiple method of deriving a multiple from the three value drivers along with explicit transition periods allows you to compute the EV/EBITDA ratio that is consistent with lower growth and corrects problems with simply applying the EV/EBITDA multiple from comparable public company analysis which is the big problem with method 3 above.

- Computing the multiple with explicit assumptions eliminates the problems associated with the value driver formula involving the difficulty of interpretation and the implicit logical errors in the formula.

- Through using the implicit formula along with regression analysis, you can derive inputs consistent with the market and use the derived formula to eliminate the large range in value that occurs with the stable growth method.

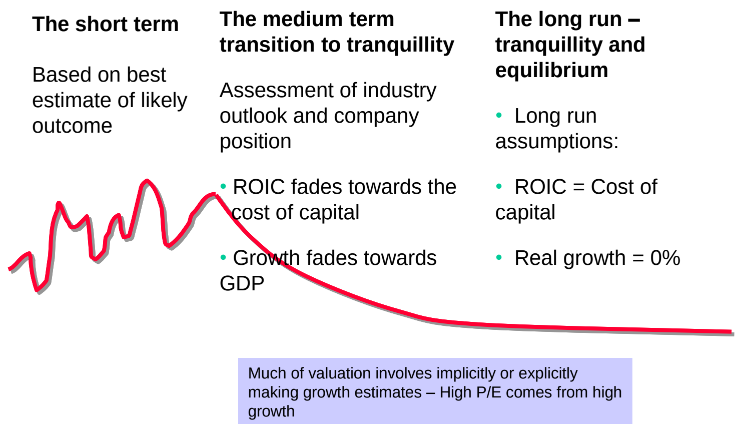
Development of a formula for the EV/EBITDA ratio that can be applied in the terminal value calculation that explicitly accounts for varying transition growth and return periods, stable ratios of capital expenditures to capital expenditures, stable depreciation rates and stable levels of deferred taxes relative to net plant.  This approach forces one to directly consider a host of variables that drive the long-term value including different rates of convergence between return and cost of capital, declines in cost of capital during stable growth periods, as well as changing growth rates and asset replacement. Advantages of this approach are that it is flexible and it reduces large variation in valuations. Disadvantages of the method are that it requires a number of somewhat complicated calculations and it is not commonly used in valuation.

The remainder of this section considers theoretical issues associated with measuring stable growth rates and resolving DCF problems using the four alternative approaches summarized above. The first part discusses theoretical and practical issues associated in applying the stable growth rate formula. The second section turns to the value driver formula and describes general issues related to the convergence of cost of capital and return on capital. This section covers how growth and cost of capital can be translated into a P/E ratio and how the derived P/E ratio can consider changes in real growth, movements in rates of return and variation in the cost of capital. The final section works through calculation of the EV/EBITDA ratio that was illustrated in the table at the beginning of the chapter. This analysis requires development of stable ratios for stable depreciation rates on net plant, stable ratios of capital expenditures to net plant and stable ratios of deferred tax to net plant which depend on the lifetime of plant and the future growth rate.

# Chapter 27: Terminal Value and Philosophy: Growth Rates Should Eventually Converge to Overall Economic Growth, But How and When

The necessity of computing terminal value in corporate models comes from the idea that, unlike humans, corporations are assumed to last indefinitely. This notion means that forecasts of items such as growth, rate of return and cost of capital on an indefinite basis cannot be avoided when valuing a company. Winston Churchill's comment that: "It is always wise to look ahead, but difficult to look further than you can see" summarises the fundamental problem when thinking about growth in a financial model. One cannot see further than a few years which begs the question of how can one possibly make a reasonable forecast of growth, return an capital and risk on an infinite basis. Given this problem, the convention in valuation is to resort to a rather vague philosophical concept rather than to attempt to make a detailed forecast. Since valuation of a corporation requires some explicit or implicit assumption with respect to growth one can begin by eliminating unreasonable assumptions. It does not make sense to assume that growth rates can occur for long periods above the overall nominal growth rate in the economy because it is easy to demonstrate that this means the company will in the not too distant future take over the economy. If you assume that Apple can continue to grow at 40% while the overall economy is growing by 3%, then in about 30 years there would be nothing other than Apple products in the economy – no food, no clothes, no cars; just iphones, ipads and other Apple products (some may believe this could be possible). This is just due to the law of large numbers. On the other hand it is just as unreasonable to assume that every company will eventually simply fail and end up in bankruptcy. As products of a company reach the end of their life cycle or become obsolete, management obsessively uses its skills to develop new products and business lines in attempting to sustain high growth and profitability. Given the two extremes -- maintaining growth above the overall economy or simply dying – the philosophy of assuming a stable growth rate is a reasonable compromise in making valuations. While this philosophy of sometime realising stable growth rates can be defended relative to other possible methods, the date at which the transition from short-term to long-term growth begins and the length of the transition period is still completely arbitrary as is the assumption for the long-term growth rate of the economy.

To resolve problems with making unreasonable high growth rate assumptions, analysts who perform discounted cash flow analysis generally make a pessimistic assumption that growth in cash flow once a terminal period occurs will be limited to the projected rate of inflation. This means that companies will stabilize to a tranquil zero real growth rate in a period of somewhere between five and ten years, perhaps after a smooth transition period until the supposed tranquillity is obtained. The typical assumptions derived from the philosophy that a company will stabilise to towards a zero real growth rate are illustrated on the graph below.




Given the well documented optimism of stock analysts, it may seem a little surprising that analysts, consultants, investment bankers and others who perform discounted cash flow analysis generally make an assumption that growth in cash flow once a terminal period occurs will be limited to the projected rate of inflation. Growth at the rate of inflation implies that there is no real growth in any company. While the assumption is commonly made, it is difficult to come up with any company -- or person for that matter -- that has reached this kind of tranquil nirvana or has managed such a transition to equilibrium. Further, if all companies somehow reach this kind of equilibrium where there is no real growth in cash flow, no companies would contribute to real economic growth and the world economy would stagnate in a never-ending recession.

When reviewing growth rate in revenues for individual companies over long time periods, one can find downward trends in growth because of the difficulty of achieving a high growth when you become really big, but not the sudden change to stable growth rates that is often assumed in the discounted cash flow model. For example, the growth rate of Microsoft has declined, but it did not happen in five years and it has not come all the way down to the overall rate of inflation. Similar examples can be found with many companies that have become large and successful (McDonalds continues to grow at 8%, Wallmart at 9% and so forth). When reviewing these large companies one should keep in mind that there is survivorship bias as smaller companies which have never grown or have failed are more difficult to acquire data. If you are valuing ABC Company, there is a chance that they will continue to grow like Samsung, and there is also a probability that they will decline to nothing as the case of Kodak. One can get into endless philosophical and economic arguments about growth rates, survivorship bias and reaching a period of stability. But when applying the DCF model, some explicit or implicit assumption is required and assuming a high rate of growth over an indefinite period is not reasonable. At the end of the day, there is no one single correct answer and it is not useful to get very emotional about the level of the growth rate. It is better to admit the growth rate is uncertain and the length of the period before which growth stabilises is also uncertain.

## Mechanics of Computing Transition Periods using the Idea of Compound Growth Rates and Switch Variables

If you would like to make a model that has a transition period like the line shown in the graph above you can use a technique that applies switch variables to a timeline introduced in Part 1 along with computing compound annual growth rates. To illustrate the mechanics of computing growth during the transition period pretend that you would like to assume growth of 15% for the first five years followed by a transition period of seven years and then a growth rate of 3%. The following step by step process can be used for developing growth rates with given short-term growth, a transition period and then a constant long-term growth rate:

Step 1: Set-up switches for the short-term period, the long-term period and the transition period

Begin the process by defining time period inputs for the short-term period and the transition period. The long-term period can then be calculated as the short-term period plus the transition period. For example, if the short-term period is five and the transition period is seven, the long-term period is twelve. Once the inputs are defined, enter the period number beginning with one and then add three rows for switch variables. The three switch variables all of which have values of TRUE or FALSE, have the following values:

- The first switch variable is simply a comparison of the period number with the definition of the short-term as: period <= short-term period.
- For the second row of switches, define the long-term period as: period > long-term period (where he long term period was defined as the short-term period plus the transition period).
- The transition period can be simply defined as the equivalence of the short-term period and the long-term period. This is because during the short-term period and the long-term period there is one TRUE and one FALSE while in transition period there are two values of FALSE in each column. Because of this, the transition period can be simply defined as:

Transition Period = (Short-term Period = Long-term Period)

Step 2: Compute compound growth rates for interpolation in the transition period

During the transition period the various different variables gradually move from the level defined at the end of the short-term period to the long-run stable amount. In computing the value on a period by period basis in the transition period, a compound growth rate can be used to interpolate different values. Once the growth rate is computed, the value during the transition period can be established using the following formula:

Value = Value x (1 + growth rate)

In computing the growth rate, a standard compound annual growth rate equation can be applied using the long-term value and the short-term value. When applying the formula, the number of periods that you should use is the number of transition years plus one.

Growth Rate = (Long-term value/Short-term value) ^(1/(transition years+1))

To see why you must add one in the above formula, consider a simple example where the transition period is only one year. If the transition factor were computed without adding one, the growth rate would be the ratio of the long term value to the short term value yielding a simple growth rate. With a transition period of one year, if this simple growth were multiplied by the short-term value, the transition year would contain the long term amount and not something in-between (the long-term value should be in the year after the transition period). On the other hand, when the transition factor is computed through adding a year to the transition period, then the transition factor correctly measures the CAGR because the transition adds another year to the process. Using the example with a short-term value of 10 and a long-term value of 15 along with a one year transition period, the transition factor would be:

Transition Factor = (Long-term/Short-term) ^(1/(transition years+1) = (15/10)^(1/2) = 1.225

Step 3: Compute compound growth rates for interpolation in the transition period

Given different TRUE and FALSE values for the switches, the transition factors and the long and short-term parameters, the period by period values for growth, return and other factor can be computed using the following formula if the growth rate method for transition is used:

Annual Value = Short-term Value x Short-term Switch +

Long-term Value x Long-term Switch +
Last Year Value x Growth Rate x Transition Switch

| | |
|---|---|
| **Transition Factors** | |
| Inflation Transition | 1.20 |
| Risk Premium Transition | 0.87 |
| Return above COC Transition | 0.83 |
| Growth Rate Transition | 0.92 |

| **Model** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Short-term Switch | | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Long-term Switch | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE |
| Transition Switch | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | FALSE |
| Inflation Rate | | 1.00% | 1.00% | 1.00% | 1.00% | 1.00% | 1.20% | 1.44% | 1.73% | 2.08% | 2.50% |
| Real Interest Rate | | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% | 1.50% |
| Nominal Interest Rate | | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% | 2.70% | 2.94% | 3.23% | 3.58% | 4.00% |
| Risk Premium | | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 3.48% | 3.03% | 2.64% | 2.30% | 2.00% |
| Total Cost of Capital | | 6.50% | 6.50% | 6.50% | 6.50% | 6.50% | 6.18% | 5.97% | 5.87% | 5.88% | 6.00% |
| Risk Premium | | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 4.16% | 3.47% | 2.89% | 2.40% | 2.00% |

## Mechanics of Computing Explicit Cash Flow and Terminal Value in a Flexible way with Different Starting and Ending Points

In subsequent chapters, conceptual problems associated with computing terminal value using different approaches are discussed in detail. Before considering the numerous theoretical challenges arising from different growth and rate of return assumptions associated with the terminal value calculation, a couple of mechanical issues associated with computing the discounted cash flow in an annual model are addressed. To illustrate timing and discounting issues, this section begins by assuming that the value of a company after reaching the stable period is given by the standard continuing growth model:

TV = [Free Cash Flow in Terminal Period x (1+terminal growth)]/(WACC – terminal growth)

This formula was previously applied in demonstrating how to prove different valuation concepts related to the bridge between equity value and enterprise value. The reason the growth rate is in the numerator of the formula is due to the mathematics (integration) of discounting cash flows. This comes from the fact that the value of a cash flow in perpetuity is the next period cash flow – not the current period cash flow -- divided by the discount rate.

If an annual model is used for valuation and the standard excel NPV formula is applied then you are implicitly assuming that the cash flows all occur at the end of the year -- a company selling food would receive all of its revenues, pay all of its expenses and incur all of its capital expenditures at midnight on December 31st. This assumption is unrealistic and can result in an error as not all revenues suddenly occur on the last day of December of each year and each valuation does no happen on the first of January of the year. Cash flows actually occur in small increments – day by day or hour by hour – and if your model uses annual periods, a reasonable approximation of this is to assume that cash flows occur in the middle of the year. However, if the company were to be sold and valued at the end of some holding period, this cash flow from selling the company does occur at a single point in time rather than over small increments. If more realistic timing assumptions are in a valuation model rather than end of year assumptions, the measured value of the company is slightly increased.

To correctly incorporate timing of cash flows in a model it can be helpful to draw a time line as shown in the diagram below. Drawing a time line demonstrates that the discount factor should be different for the terminal value as opposed to the periodic cash flows.

| | | | | | | |
|---|---|---|---|---|---|---|
| WACC | 10% | | | | | |
| Growth Rate | 5% | | | | Dec Cash Flow | 118.66 |
| | 100 | 105 | 110.25 | 115.76 | CF x 1+g | 124.59 |
| | | | | | Value of TV | 2,491.79 |
| | Value at 1 Jan | | | | | |
| | Cash at 1 July | | Cash at 1 July | | | |
| | | | | Sell at 31 Dec | | |
| | | | | | | |
| Discount Period | 0.5 | 1.5 | 2.5 | 3.5 | | |
| CF Discount Factor | 0.95 | 0.87 | 0.79 | 0.72 | | |
| Terminal Period | | | | 4.0 | | |
| TV Discount Factor | | | | 0.68 | | |
| Value of Cash Flow | 95.35 | 91.01 | 86.88 | 1,784.85 | | |
| Sum | 2,058.09 | | | | | |
| | | | | | | |
| EOY Discounting | 100.00 | 105.00 | 110.25 | 2,546.78 | | |
| NPV | 2,000.00 | | | | | |
| | | | | | | |
| Percent Difference | 2.90% | | | | | |

You can work through the time line shown in the above formula and use different discount factors for the explicit cash flows and the terminal cash flow. Alternatively you can create a theoretical long-term model where the company is not sold, but it instead lasts for something like 300 years. If the company is not sold, the value of the company should be the same as you compute a terminal value. This process demonstrates that all of the business of mid-year discounting ends up in the following simple formula and process.

- Compute the value of explicit cash flows and the value of the terminal value as if you were using the end of year cash flows, meaning that you can use the regular old NPV formula in excel.

- Multiply the final result by (1+WACC) ^ .5 for the half year assumption.

To demonstrate that this formula works, you can create a proof in an analogous manner to the approach demonstrated above associated with the bridge between enterprise value and equity value. This involves creating a model where the company remains in place for 300 years and cash flows are realised in the middle of the year for the whole period. The value of these cash flows establishes the target value that should be obtained from the sum of the value of the explicit cash flow plus the value of the terminal cash flow. When you assume that the explicit cash flows occur at the middle of the period and the terminal value occurs at the end of the period, but the buyer makes a valuation from receipt of cash flow in the middle of the period, the valuation is the same as the simple formula shown above. If you create a model with a multiple rather than the continual growth assumption, you can argue that a more complex adjustment is necessary. Further, if the WACC changes over time the adjustment is more complex as explained below.

| Model | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Timing | | | | | | | | | | | | | |
| Year | Periods | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
| Date of Cash Flow | | | 01-janv-16 | 01-janv-16 | 01-juil-16 | 01-juil-17 | 01-juil-18 | 01-juil-19 | 01-juil-20 | 01-juil-21 | 01-juil-22 | 01-juil-23 | 01-juil-24 |
| Terminal Period | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE | FALSE |
| Explicit Period | 6 | | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE |
| Valuation Period | 299 | | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Short-term Growth Period | 8 | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE |
| Long-term Growth Period | 293 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE |
| | | | | | | | | | | | | | |
| Theoretically True Value | | | | | | | | | | | | | |
| Growth Rate | | | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 3.00% | 3.00% | 3.00% |
| Cash Flow | | 100.00 | 120.00 | 144.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | 442.88 | 456.17 | 469.85 |
| Cash Flow over Valuation | | | FALSE | FALSE | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | 442.88 | 456.17 | 469.85 |
| Theoretical Value with 1/2 Year | | 4,988.05 | | | | | | | | | | | |
| Cash Flow with zeros in initial period | | | 0.00 | 0.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | 442.88 | 456.17 | 469.85 |
| Check with XNPV | | 4,983.90 | | | | | | | | | | | |
| Application of TV | | | | | | | | | | | | | |
| Expicit Cash Flow Value (EOY) | | 1,184.56 | FALSE | FALSE | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | FALSE | FALSE | FALSE |
| Terminal Value | | 3,571.36 | FALSE | FALSE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6,326.87 | FALSE | FALSE | FALSE |
| Enterprise Value (EOY) | | 4,755.92 | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Timing Adjustment (1+WACC)^.5 | | 4,988.05 | | | | | | | | | | | |

## Difficulty of Computing Value with Changing WACC and a Midyear Convention

The example above works well when the WACC is constant in each period, but not if the WACC changes from one period to another.[1] WACC should not really be changed when the capital structure changes but it could change from different inflation rates or a sensible assumption that the risk is lower when things are assumed to stabilise. When the WACC changes, one cannot use the formula 1/(1+WACC)^period to discount cash flows because this formula has no memory of prior cash flows. If there was a high rate of inflation in the past or the risk changes, the value of prospective cash flows depends on the prior value but the discounting formula does not account for the prior values. Instead of using the old fashion discount factor you can create a compound index like you make an inflation index. Instead of using the inflation rate, use the WACC. Then, when you compute the PV of the cash flow, you can apply the SUMPRODUCT function with a divide sign as illustrated below (excel explanation of the formula does not include the operators like multiply and divide which make the SUMPRODUCT so much better):

NPV = SUMPRODUCT(Cash Flow Array/Compound WACC Index Array)

Applying a mid-year cash flow assumption together with a changing WACC is more challenging. In this case the compounding formula should include half of the current year WACC and half of the prior year WACC. For the very first year the prior year WACC is zero. Further, when applying the half year WACC one must account for partial year compounding to be precise. Formulas for computing the compound discount rate include:

Half year discount rate with compounding = (1+WACC) ^ .5

$$\text{Compound Factor}_t = \text{Compound Factor}_{t-1} \times (1 + 1/2 \text{ yr rate}_t) \times (1 + 1/2 \text{ yr rate}_{t-1})$$

When computing the terminal value, the normal formula CF x (1+g)/(WACC-g) can be used, but it must be discounted to the present using the compound factor above. As with the simple case where the WACC does not change, the efficacy of the method can be demonstrated through creating a theoretically true value. An excerpt from this sort of analysis along with a display of the various formulas is shown below.

[1] If you would like to read all about cost of capital and problems with the CAPM and levered Betas, you can read my other book.

| | | | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | Timing | | | | | | | | | | | |
| 24 | Year | Periods | | | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
| 25 | Date of Cash Flow | | | | 01-juil-14 | 01-juil-15 | 01-juil-16 | 01-juil-17 | 01-juil-18 | 01-juil-19 | 01-juil-20 | 01-juil-21 |
| 26 | Terminal Period | 1 | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE |
| 27 | Explicit Period | 8 | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| 28 | Valuation Period | 301 | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| 29 | Short-term Growth Period | 8 | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| 30 | Long-term Growth Period | 293 | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| 31 | Year Counter | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 32 | | | | | | | | | | | | |
| 33 | Theoretically True Value | | | | | | | | | | | |
| 34 | Growth Rate | | | | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% |
| 35 | WACC | | | | 25.00% | 25.00% | 25.00% | 25.00% | 12.00% | 12.00% | 8.00% | 8.00% |
| 36 | 1/2 Year WACC | | =(1+H35)^0.5-1 -----> | | 11.80% | 11.80% | 11.80% | 11.80% | 5.83% | 5.83% | 3.92% | 3.92% |
| 37 | | | | | | | | | | | | |
| 38 | Cash Flow | | | 100.00 | 120.00 | 144.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 |
| 39 | | | | | | | | | | | | |
| 40 | Incorrect PV Factor | | | | 0.80 | 0.64 | 0.51 | 0.41 | 0.57 | 0.51 | 0.58 | 0.54 |
| 41 | Compound PV Factor | | =G41*(1+H35) -----> | 1.00 | 1.25 | 1.56 | 1.95 | 2.44 | 2.73 | 3.06 | 3.31 | 3.57 |
| 42 | | | | | | | | | | | | |
| 43 | PV of Cash Flow with Varying WACC | 3,258.44 | <----- =SUMPRODUCT(H38:KV38/H41:KV41) | | | | | | | | | |
| 44 | | | | | | | | | | | | |
| 45 | PV Factor for Middle of Year | | =G45*(1+G36)*(1+H36) -----> | 1 | 1.12 | 1.40 | 1.75 | 2.18 | 2.58 | 2.89 | 3.18 | 3.44 |
| 46 | True Value of Cash Flow | 3,418.36 | <----- =SUMPRODUCT(H38:KV38/H45:KV45) | | | | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | Replication of Value with Teminal Value | | | | | | | | | | | |
| 49 | Explict Value | 841.42 | | | 120.00 | 144.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 |
| 50 | | | =H49*(1+$E$7)/(H35-$E$7)*H26 -----> | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 8,857.62 |
| 51 | Terminal Value with Normal Formula | 2,576.95 | <----- =SUMPRODUCT(H50:KV50/H45:KV45) | | | | | | | | | |
| 52 | Enterprise Value | 3,418.36 | | | | | | | | | | |

# Chapter 28: The Importance of Normalising Cash Flows in the Terminal Year to Assure that Cash Flows are Consistent with Stable Growth Rates in the Relatively Simple Case of Working Capital

The next few chapters consider various adjustments to terminal cash flow and to terminal value formulas that are necessary to accurately measure value when growth rates move from short-term assumptions to long-term stable rates and when rates of return on investment stabilise. When reviewing articles about valuation you can comb the internet and find hundreds of references to normalising cash flow in the terminal period. But you cannot find anybody who explains how you should adjust the cash flow from a practical standpoint. Modelling issues in which the effects of changing growth and rate of return come into play include normalising cash flow in the terminal period, computing terminal value using the value driver formula (1-g/ROIC/(WACC-g)) and deriving implied P/E and EV/EBITDA ratios. For all of these issues associated with the terminal value, a changing growth rate affects the modelling of investments in working capital, capital expenditures, depreciation and deferred tax.

To understand both the valuation theory and the modelling mechanics with respect to changes in growth it is convenient to begin the discussion with working capital and then proceed to capital expenditures, depreciation and deferred taxes. Working capital is simpler to analyse than capital expenditures, depreciation and deferred tax. Once the modelling of working capital is established, you will have a stepping stone to understand the more difficult issues associated with depreciation, capital expenditures and deferred taxes that arise because unlike working capital, the capital assets have a lifetime of more than one year. Analysis of capital expenditures and depreciation is more complex than working capital because depreciation is influenced by historic expenditures made over the prior life cycle of plant. In the case of working capital, the effects of a change in growth are immediate and there is no necessity to evaluate an entire life cycle of plant.

## When Adjusting Growth Rates of Revenues a Host or other Things Change Including Working Capital Investment, Capital Expenditures, Depreciation, Deferred Taxes and Income Taxes

When the growth rate in revenue changes because of a lower stable terminal growth rate, analysts often do not assume that other items of cash flow including working capital changes and capital expenditures

change to support different growth rates. In the explicit forecast period capital expenditures and working capital investment explicitly or implicitly support the EBITDA growth. When the growth rate changes, the investment made to support the changing growth should also change. An assumption that capital investment and working capital remain at levels that were consistent with growth during the explicit period but that prospective stable EBITDA has a different (generally lower) growth rate creates a number of inconsistencies that can distort valuation. Working capital investment and capital expenditure are wrong from the terminal period to year 300 or more. If the revenues grow at a slower rate after the explicit period, then the rate of EBITDA also slows which means that less working capital investment and capital expenditures are required to support the slower EBITDA growth. In addition, with lower capital expenditures, there will be less deferred taxes and the ratio of depreciation expense relative to the EBITDA will change. Accurately modelling the manner in which investment changes when growth rate changes should be an essential part of the modelling and valuation process. From the perspective of the free cash formula where free cash flow equals EBITDA less working capital changes less capital expenditures less operating tax less change in deferred tax, each of the items that are subtracted from EBITDA should be normalised to be consistent with the terminal growth rate.

When creating a corporate model the normal assumption is that when revenues and income changes, the working capital changes in direct linear manner with revenues. Most of the time, accounts receivable are modelled as a percent of revenues and operating costs are also expressed as a percent of revenue. This implies that accounts payable and inventories also move in direct proportion to revenues. If the growth rate in revenues slows, then the growth of working capital will also slow. The problem occurs because in the last year of the explicit forecast period, the revenue growth does not reflect the new terminal growth rate. But the working capital investment in future will decline if the terminal growth rate is lower than the growth rate in the terminal period. The decline in revenues from the lower terminal growth rate is reflected in the valuation because the cash flow implicitly grows at the terminal growth rate when the formula TV = Final Year Cash Flow x (1+terminal growth)/(WACC – terminal growth) is applied. Nothing in this formula adjusts for the prospective lower investment in working capital associated with the lower growth rate. A downward bias in valuation arises because working capital changes in the final year cash flow are not consistent with working capital changes that would be present with a lower terminal growth rate.

To illustrate this problem pretend that revenue growth is 50% in the final explicit forecast year that results in a revenue level of 150 for cash flow at the end of the year. Also assume: (1) that the terminal growth is 3%; (2) the company only has revenues and accounts receivable and (3) the increase in working capital due to the revenue increase in the terminal year is 50. The cash flow in the final year cash flow subtracts a large number for investment in working capital that is derived from the projected 50% growth. If the standard perpetuity formula is applied, the last year cash flow of revenues less working capital investment of 100 is implicitly assumed to grow at 3%. This means the 150 revenues are assumed to grow at 3% and also the working capital investment of 50 is assumed to grow at 3%. However if revenues only grow by 3% the working capital investment will be much less and the starting cash flow should be higher. To solve this problem you should create a separate calculation for the terminal year cash flow that includes normalised working capital investment.

### Developing a Simple Equation for the Stable Ratio of Working Capital Change to Normalise Cash Flow after the Explicit Forecast Period

A relatively simple formula can be used to adjust the terminal cash flow and to normalise working capital changes in the terminal year. If assumptions for the days accounts receivable, days accounts payable, days of inventory and the operating margin are constant, then the level of working capital relative to EBITDA will also be constant. With the constant ratio of working capital to EBITDA, the working capital in a period can be expressed as:

$$\text{Working Capital}_{t-1} = \text{Working Capital/EBITDA x EBITDA}_{t-1}$$

and,

$$\text{Working Capital}_t = \text{Working Capital/EBITDA} \times \text{EBITDA}_{t-1} \times (1 + \text{growth})$$

These to formulas imply the following:

$$\text{Working Capital Change} = \text{Working Capital/EBITDA} \times (\text{EBITDA}_{t-1} \times (1+\text{growth}) - \text{EBITDA}_{t-1})$$

or,

$$\text{Working Capital Change} = \text{Working Capital/EBITDA} \times \text{EBITDA}_{t-1} \times \text{growth}$$

substituting $\text{EBITDA}_t/(1+\text{growth})$ for $\text{EBITDA}_{t-1}$, gives:

**Working Capital Change = Working Capital/EBITDA x $\text{EBITDA}_t$ x growth/(1+growth)**

This formula can be used in a model so that when the terminal growth changes, the terminal working capital will also change. When implementing this formula in a model, the free cash flow for purposes of computing terminal value should use the working capital change from the above formula rather than the working capital computed from explicit period cash flow. Cash flows during the explicit period remain the same.

To demonstrate that this formula produces a correct valuation you can create a long-term proof. In creating such a proof, you can make one scenario where the model continues for a couple of hundred years and the true theoretical value is derived from the long-term cash flow with changing growth rates. Next, you can simulate valuation in a case with an explicit period, a terminal value and with no adjustment for normalising working capital investment. This second case will show that the valuation is biased. Finally you can create third case that normalises working capital changes in the terminal period and demonstrates that the normalised cash flow produces the same value as the first case that simulated cash flow for hundreds of years.

The following few steps show how to develop a model that contains such as a proof. An excerpt of the spreadsheet proof using these steps is demonstrated below.

Step 1: Create a long-term model to compute the theoretical true value. Make a model that includes growth rates which changes from a high rate in the explicit period to a low terminal growth rate using a short-term switch and a long-term switch. Compute revenues, working capital level and the change in working capital using the changing growth rates over a long period to establish the true value. Calculate free cash flow from revenues less working capital changes and discount free cash flow over the entire period to compute the true value.

Step 2: Use the same inputs to compute valuation with a terminal value and no stable period adjustment. Add switches for the holding period and the terminal period and compute value from the explicit period cash flow plus the terminal value rather than over the entire period. Compute the explicit period value using the explicit period switch and the terminal value using the terminal value switch through applying the perpetuity formula to the terminal period cash flow. The value computed from this method produces a different number than the true value created from the analysis that extends for the long period in step 1.

Step 3: Use the same switches from step 2 but add a calculation for the stable working capital change in the terminal value cash flow using the formula:

Working capital change = Working capital/EBITDA x EBITDA x terminal growth/(1+terminal growth)

Replace the working capital change in the terminal value formula with this working capital equation to normalise cash flow in the terminal period. When the present value of the terminal value is recomputed, the total value is the same as the value in step 1.

The excerpt below shows that the true value of the corporation is obtained when the adjustment is made and that the valuation is biased if the free cash flow from the explicit period is applied (the terminal period is shaded in grey using conditional formatting).

| Model | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Explicit Period | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Terminal Period | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE |
| Short-term Growth Period | | | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Long-term Growth Period | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| **Theoretical Value** | | | | | | | | | | | | |
| Growth Rate | | | 30% | 30% | 30% | 30% | 30% | 30% | 30% | 30% | 30% | 30% |
| Revenues | | 100 | 130.00 | 169.00 | 219.70 | 285.61 | 371.29 | 482.68 | 627.49 | 815.73 | 1,060.45 | 1,378.58 |
| Operating Expense | 20% | | 104.00 | 135.20 | 175.76 | 228.49 | 297.03 | 386.14 | 501.99 | 652.58 | 848.36 | 1,102.87 |
| | | | | | | | | | | | | |
| A/R Level | 25% | 25.00 | 32.50 | 42.25 | 54.93 | 71.40 | 92.82 | 120.67 | 156.87 | 203.93 | 265.11 | 344.65 |
| Change in Working Capital | | | 7.50 | 9.75 | 12.68 | 16.48 | 21.42 | 27.85 | 36.20 | 47.06 | 61.18 | 79.53 |
| | | | | | | | | | | | | |
| Free Cash Flow | | | 18.50 | 24.05 | 31.27 | 40.64 | 52.84 | 68.69 | 89.30 | 116.08 | 150.91 | 196.18 |
| **PV of Free Cash Flow - True Value** | **1,721.26** | | | | | | | | | | | |
| **Valuation using Terminal Value without Stable Period Adjustment** | | | | | | | | | | | | |
| Explicit Cash Flow | 399.14 | | 18.50 | 24.05 | 31.27 | 40.64 | 52.84 | 68.69 | 89.30 | 116.08 | 150.91 | 196.18 |
| Terminal Cash Flow | 964.37 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2,501.34 |
| **Enterprise Value without Adjustment** | **1,363.51** | | | | | | | | | | | |
| **Valuation using Terminal Value with Stable Period Adjustment** | | | | | | | | | | | | |
| WC to EBITDA | | | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Terminal Growth | 2% | | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| Stable WC Change | | | 0.64 | 0.83 | 1.08 | 1.40 | 1.82 | 2.37 | 3.08 | 4.00 | 5.20 | 6.76 |
| Stable Cash Flow | 10% | | 25.36 | 32.97 | 42.86 | 55.72 | 72.44 | 94.17 | 122.42 | 159.15 | 206.89 | 268.96 |
| Terminal Cash Flow | 1,322.12 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3,429.23 |
| Explcit Cash Flow | 399.14 | | | | | | | | | | | |
| **Total EV with Adjustment** | **1,721.26** | | | | | | | | | | | |

## Mechanics of Incorporating Stable Working Capital Ratios and Other Stable Ratios in a Corporate Model

Once the formula for stable ratio of working capital changes relative to growth and EBITDA has been established, the normalised working capital should be entered into a corporate model in transparent and flexible manner. The normalised cash flow calculation should be able to work with different terminal time period assumptions, with different working capital assumptions, with different stable growth rates and with different EBITDA levels that derive from explicit period assumptions. In structuring a corporate model to include these various items, effective presentation may be the most essential thing to do. A few ideas in presenting normalised cash flow include:

- You can create an input variable that is TRUE or FALSE which is used to apply the normalised or un-adjusted cash flows in computing the terminal value.

- Include rows that show the EBITDA, working capital and the ratio of EBITDA/working capital and the terminal growth rate that are drivers for the stable ratio calculation.

- Add a separate line for the normalised working capital change that comes from the formula discussed in this section.

- Compute normalised cash flow separately from cash flow over the holding period that can be discounted at a different discount factor from discounting the cash flow over the explicit period as discussed in discounting using a ½ year convention above.

| Timeline | Custom Case | | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| Historic timeline switch | 13 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Explicit period switch | 8 | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE | TRUE |
| Valuation year | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Closing Balance Sheet for valuation | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Terminal value switch | 1 | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE |
| **Normalised Cash Flow Analysis** | | | | | | | | | |
| Apply Normalised Ratios | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| EBITDA - Midyear | | | 366,698 | 375,245 | 384,006 | 407,467 | 471,058 | 499,562 | 529,911 |
| Growth Rate in EBITDA | | | 14.16% | 2.33% | 2.33% | 6.11% | 15.61% | 6.05% | 6.08% |
| Working Capital | | | 150,770 | 161,414 | 172,626 | 183,183 | 194,246 | 205,838 | 217,984 |
| Working Capital to EBITDA | | | 41.12% | 43.02% | 44.95% | 44.96% | 41.24% | 41.20% | 41.14% |
| Terminal Growth | | 2% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| Stable WC Change as Percent of EBITDA | | | 0.81% | 0.84% | 0.88% | 0.88% | 0.81% | 0.81% | 0.81% |
| Stable WC Change | | | 2,956.27 | 3,164.99 | 3,384.82 | 3,591.81 | 3,808.74 | 4,036.04 | 4,274.19 |
| **Normalised Cash Flow inTerminal Period** | | | | | | | | | |
| EBITDA | | | - | - | - | - | - | - | 529,910.67 |
| Less: Stabalised Working Capital | | | - | - | - | - | - | - | 4,274.19 |
| Less: EBIT x Tax from Levelised Depreciation | | | | | | | | | |
| Less: Levelised Stable Capital Expenditures | | | | | | | | | |
| Add: Levelised Stable Deferred Taxes | | | | | | | | | |
| Normalised Cash Flow in Terminal Period before Growh Adjustment | | | - | - | - | - | - | - | 525,636.47 |
| Normalised Cash Flow Adjusted for Added 1/2 Growth | | | - | - | - | - | - | - | 541,602.86 |
| **Discount Rate for Terminal Value and Explicit Period** | | | | | | | | | |
| Discount Rate | | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% |
| Discount Index for Terminal Value | | 1.00 | 1.17 | 1.26 | 1.36 | 1.47 | 1.59 | 1.71 | 1.85 |
| Prior Discount Rate | | | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% |
| Weighted Discount Rate | | | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% | 8.00% |
| Discount Rate for Explicit Cash Flows | | 1.00 | 1.12 | 1.21 | 1.31 | 1.41 | 1.53 | 1.65 | 1.78 |

The section of the above titled “Normalised Cash Flow in Terminal Period” demonstrates that you should think about each of free cash flow line items when normalising cash flow. The normalised EBITDA should be consistent with a sustainable ROIC computed using all of the techniques discussed above. If the ROIC in the terminal period is not consistent with levels that can be sustained, the valuation will not be reasonable.

# Chapter 29: Understanding the Relationship between Growth, Capital Expenditures and Depreciation as Background in Deriving Implied Growth Rates from Depreciation, Stable Ratios in Terminal Year, and Implied EV/EBIDA Ratios

If you could come up with formulas for depreciation, capital expenditures and deferred tax in the same sort of way that the stable working capital formula was discussed above, adjusting valuation analysis for stable ratios would be relatively simple. You could make a routine adjustment in the valuation sections of corporate models through adding alternative calculations for working capital, capital expenditures and deferred taxes in the terminal free cash flow calculation with the terminal period switch. A similar adjustment could be made in using the stable ratios to evaluate implicit multiples and in evaluating the value driver formula. While the approach of using a formula for is straightforward for working capital changes, finding easy formulas to apply for capital expenditures and deferred taxes is more complex because of time lags in adjusting ratios to the stable ratios after a growth rate change.

The body of this chapter describes to come up with a user defined function for the ratio of capital expenditures to depreciation that you can plop into any corporate model from information that is readily available from data in financial reports. This function accepts the historic growth rate, the WACC, future growth and the plant life to compute a ratio of capital to depreciation to plug into the terminal cash flow. Application of two functions for computing terminal year cash flow are illustrated with the two formulas below:

Historic Growth = find_growth(Accumulated Depreciation to Plant, Life)

Stable Capital Expenditures = stable_cap_exp(Historic Growth, Future Growth, Life, WACC)

With these two functions, the valuation section of a corporate model can include stable ratios for working capital changes as well as stable capital expenditures in the stabilised terminal cash flow. In a subsequent, chapter similar adjustments are discussed for deferred tax changes associated with capital assets. Finally, the subject of how to adjust terminal value for stable capital expenditures and depreciation does not only apply to stable ratios in the free cash flow analysis. A similar problem arises in applying the value driver formula where the stable level of depreciation in the terminal period NOPLAT exists and the problem also exists when computing the implicit EV/EBITDA ratio. The remainder of this chapter explains how to derive the stable capital expenditure function. As with other corporate valuation problems, the function is derived from evaluating a theoretical long-term analysis where the corporation has an indefinite life. One to the challenges is to derive the function that correctly accounts for changes in growth between the explicit modelled period and the terminal period.

## Computing the Long-term Stable Ratio of Capital Expenditures to Depreciation and Depreciation Expense to Net Plant when Growth Rates Change

The general question of how to compute capital expenditures in the DCF model is important in valuation, particularly in the terminal period. Some level of capital expenditures is needed to generate the EBITDA consistent with the assumed long-term stable growth rate just as a level of working capital investment is necessary to earn income. If capital expenditures in the past few years have been relatively low (perhaps because of surplus capacity) and one assumes that the future capital expenditures will be consistent with the recent past, then your valuation will be too high because the EBITDA cannot grow over an indefinite period from the low level of capital expenditures. On the other hand, if the capital expenditures have been high and they are assumed to grow from a high base, assuming the EBITDA will decline along with the terminal growth assumption will produce to valuation which is too low as capital expenditures are subtracted from free cash flow. The big question is if and how this mysterious level of sustainable capital expenditures can be computed from available financial data.

In deriving a stable level of capital expenditures it is often convenient to express the capital expenditures as a percent of depreciation expense. The ratio of capital expenditures to sales or the level of capital expenditures to EBITDA could also be computed, but these ratios depend on assumptions with respect to the return on investment. To understand the relationship between capital expenditures and depreciation, consider a case where a company does not grow in nominal terms. Here, the depreciation expense covers the amount of money that is required to replace retiring assets. If the level of periodic capital expenditures equal the depreciation expense in this no growth case and the return on investment remains constant, then the expenditures will support the continuing EBITDA. If a company is growing in nominal terms, then the capital expenditures should be greater than the depreciation expense. Here, the capital expenditures include the replacement of assets as well as increases in capital expenditures resulting from growth. This occurs even if the growth is only nominal growth resulting from inflation as the depreciation expense measures past expenditures and the capital expenditures are expressed in current currency.

To rectify the problem of assuming capital expenditures that are far too low or far too high in relation to EBITDA, analysts sometimes simply assume that a level of capital expenditures equal to depreciation will sustain the EBITDA growth. This means that in the terminal year, one can compute the capital expenditures directly from the depreciation expense. While this may seem to be too simple of a rule of thumb, it does have some logic. If there were no growth the plant balance would be sufficient to maintain the EBITDA. There are however a few problems with this method of equating depreciation and capital expenditures. First, if inflation and growth has occurred in the past, the depreciation expense can dramatically understate the required replacement capital expenditures because depreciation by definition lags the capital expenditure. Second, the timing of retirements of existing capital can affect the future requirements. Third if the nominal growth rate is above zero, the capital expenditures should exceed the depreciation expense.

Developing a formula to compute the sustainable ratio of capital expenditures to depreciation after a full life cycle of plant has been developed is analogous to deriving the sustainable payout ratio from the growth rate in equity analysis and computing the stable ratio of working capital ratio changes discussed in

the last chapter. Using the notion that the growth requires a ratio of capital expenditures that is above one, the formula for prospective growth with a stable growth rate in assets can be expressed as follows:

Growth = Depreciation Rate on Net Plant x (Capital Expenditures/Depreciation – 1)

This formula for stable or sustainable growth is analogous to the growth rate formula for earnings that is driven by the retention rate (growth = ROE x (1-payout ratio)). As with the retention rate formula which is more useful when it is arranged to payout ratio = 1 - growth/ROE, it is useful to re-arrange the capital expenditure growth formula and compute the ratio of capital expenditures to depreciation as a function of the depreciation rate and the growth rate. If there was no problem with the life cycle of assets and if one could easily establish the net plant depreciation rate, then one could stop with this formula.

Capital Expenditures/Depreciation = Growth/Net Depreciation Rate + 1

The above formula implies that if the stable growth rate is zero, then the ratio of capital expenditures to depreciation is equal to unity. If the stable growth rate is positive, the longer the life, the higher the required capital expenditures to support growth -- as depreciation is relatively low because it includes older assets. Further, if the lifetime of assets is only one year and the depreciation rate is 100%, then the formula for capital expenditures to depreciation becomes the one plus the growth rate. This makes sense, as the capital expenditures must cover the retirements from the past year -- to get to 100% -- and also increase by the growth rate required for the growth in EBITDA.

One problem with the above formula is that you probably do not know the net depreciation rate (the gross depreciation cannot be used). The net depreciation rate is not like the gross depreciation rate which is simply one divided by the book life. Unlike the gross depreciation rate, the net depreciation rate depends on the growth rate. The gross depreciation rate is one divided by the plant life and does not depend on the growth rate. If the growth rate is very high, the depreciation on net plant approaches the depreciation rate on gross plant, but if the growth rate is low, the depreciation rate on net plant can be much higher than the depreciation rate on net plant.

To compute the stable rate of capital expenditures to depreciation under a stable growth assumption, you can create a relatively simple user-defined function that computes the net depreciation rate. The net depreciation rate depends on two things -- the life of the plant and the growth rate. Computing the net depreciation rate as a function of the growth rate and the plant life can be accomplished by working through a life cycle of plant where the capital expenditures continue to grow over the lifetime of an investment. Once the life cycle is complete, the retirements of plant offset the new additions and the net plant depreciation rate stabilises as long as the growth rate does not change. The function below for the net depreciation rate along with the formula above, you can input the growth and the depreciation rate and derive the stable level of capital expenditures to depreciation. Similar functions can be created for the ratio of accumulated depreciation to net plant, capital expenditures to depreciation, retirement rates and other ratios. The functions can be created by either assuming that the depreciation is computed on the basis of the opening balance or the closing balance.

```
Function net_depreciation_rate(life, growth)

cap_exp = 100
plant_balance = 0

For i = 1 To life + 1

    net_plant = plant_balance - accum_dep                    ' Opening Balance

    depreciation = plant_balance / life                      ' Depreciation on Opening Balance

    cap_exp = cap_exp * (1 + growth)                         ' Capital Expenditure After Depreciation

    plant_balance = plant_balance + cap_exp                  '   Closing Balances
    accum_dep = accum_dep + depreciation

Next i

net_depreciation_rate = depreciation / net_plant             ' Depreciation Rate after

End Function
```

The table below demonstrates that relative to the gross plant depreciation rate, the net plant depreciation rate is highest when the growth rate is slow and when the life of the plant is long. With a short life and a very high rate of growth, net plant is similar to the gross plant and the net plant depreciation rate is similar to the gross plant depreciation rate.

| | Gross Plant Depreciation Rate | Net Plant Depreciation – Growth Rate | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Life | | -1% | 0% | 1% | 2% | 5% | 10% | 15% | 20% | 30% | 50% | 100% |
| 1 | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| 2 | 50.00% | 66.78% | 66.67% | 66.56% | 66.45% | 66.13% | 65.63% | 65.15% | 64.71% | 63.89% | 62.50% | 60.00% |
| 5 | 20.00% | 33.56% | 33.33% | 33.11% | 32.90% | 32.28% | 31.35% | 30.51% | 29.77% | 28.49% | 26.61% | 24.03% |
| 10 | 10.00% | 18.46% | 18.18% | 17.91% | 17.66% | 16.95% | 15.94% | 15.11% | 14.44% | 13.43% | 12.23% | 11.10% |
| 15 | 6.67% | 12.80% | 12.50% | 12.22% | 11.95% | 11.23% | 10.29% | 9.58% | 9.06% | 8.36% | 7.67% | 7.14% |
| 20 | 5.00% | 9.84% | 9.52% | 9.23% | 8.96% | 8.27% | 7.41% | 6.83% | 6.44% | 5.96% | 5.55% | 5.26% |
| 30 | 3.33% | 6.78% | 6.45% | 6.16% | 5.89% | 5.25% | 4.58% | 4.20% | 3.98% | 3.75% | 3.57% | 3.45% |
| 50 | 2.00% | 4.27% | 3.92% | 3.63% | 3.38% | 2.88% | 2.47% | 2.31% | 2.22% | 2.14% | 2.08% | 2.04% |
| 100 | 1.00% | 2.37% | 1.98% | 1.70% | 1.51% | 1.24% | 1.11% | 1.07% | 1.05% | 1.03% | 1.02% | 1.01% |

As with many other issues involving corporate analysis where cash flows are assumed to last indefinitely with changing growth rates, it is helpful to construct a model that can be used to demonstrate whether various techniques are effective. The alternative to creating a long-term model is to argue about different formulas in theory that are very difficult to envision. In the case of the relationship between capital expenditures and depreciation, a life cycle model can be developed to illustrate the capital expenditure to depreciation formula and the net plant depreciation function shown above. The model can be extended indefinitely, but it demonstrates that all sorts of ratios stabilize at the end of the life cycle of plant as long as the growth rate is the same over the life cycle. A key part of demonstrating what happens with the ratio of capital expenditures to depreciation, the ratio of net plant to depreciation and the ratio of accumulated depreciation to gross plant is to model retirements of plant from the earlier capital expenditures. If you were simulating the long-term growth in the population of a country, you would have to measure how long people live, when they die and what the rate of births will be.

When simulating future retirements as the lag in capital expenditures, the retirements cannot be computed until a full life cycle of plant has completed. The first part of a formula for retirements should therefore be an IF statement involving the whether the year is greater than the life of the plant – before this year there are no retirements related to the capital expenditures. When the year is greater than the lifetime, the retirements should begin. After the first life cycle is complete, retirements should look

backward from the current year by the length of the life of the plant. Looking backward can be accomplished using the OFFSET function that begins with a cell and moves up or down and backward or forward:

Prospective Retirements = IF(Year >= Asset Life, OFFSET(current cell,-1,-Asset Life))

Once retirements are established, the plant balance can be defined as the opening balance plus new capital expenditures less the retirements. Depreciation expense can then be computed as the plant balance divided by the life. As with other calculations that are used to prove corporate finance concepts, the opening balance should be the basis of the formula. When a full life cycle including retirements is developed, the accumulated depreciation can be tabulated given the beginning balance of the accumulated depreciation. Then, the net investment balance is the gross investment balance less the accumulated depreciation. As with the stable ratio of capital expenditures to depreciation, other stable ratios include the ratio of depreciation to net plant, the ratio of capital expenditures to net plant and the ratio of capital expenditures to EBITDA. The excerpt below illustrates how stable ratios result using a five year life simulation and a 10% growth rate.

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lifetime of Investment | 5 | | Growth in Captial Expendtures | | | 10% | | | | | |
| Investment Balance | | | | | | | | | | | |
| Opening Balance | | 100.00 | 210.00 | 331.00 | 464.10 | 610.51 | 671.56 | 738.72 | 812.59 | 893.85 | 983.23 |
| Add: Capital Expenditures | 100.00 | 110.00 | 121.00 | 133.10 | 146.41 | 161.05 | 177.16 | 194.87 | 214.36 | 235.79 | 259.37 |
| Less: Retriements of New Assets | | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 | 110.00 | 121.00 | 133.10 | 146.41 | 161.05 |
| Closing Balance | 100.00 | 210.00 | 331.00 | 464.10 | 610.51 | 671.56 | 738.72 | 812.59 | 893.85 | 983.23 | 1,081.56 |
| Depreciation Life | | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Depreciation Rate | | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% |
| Depreciation Expense | | 20.00 | 42.00 | 66.20 | 92.82 | 122.10 | 134.31 | 147.74 | 162.52 | 178.77 | 196.65 |
| Accumulated Depreciation | | | | | | | | | | | |
| Opening Balance | | 0.00 | 20.00 | 62.00 | 128.20 | 221.02 | 243.12 | 267.43 | 294.18 | 323.60 | 355.95 |
| Add: Depreciation Expense | | 20.00 | 42.00 | 66.20 | 92.82 | 122.10 | 134.31 | 147.74 | 162.52 | 178.77 | 196.65 |
| Less: Retirements | | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 | 110.00 | 121.00 | 133.10 | 146.41 | 161.05 |
| Closing Balance | 0.00 | 20.00 | 62.00 | 128.20 | 221.02 | 243.12 | 267.43 | 294.18 | 323.60 | 355.95 | 391.55 |
| Net Plant | 0.00 | 100.00 | 190.00 | 269.00 | 335.90 | 389.49 | 428.44 | 471.28 | 518.41 | 570.25 | 627.28 |
| Cap Exp to Depreciation | | 550% | 288% | 201% | 158% | 132% | 132% | 132% | 132% | 132% | 132% |
| Net Plant Deprecition Rate | | 20.0% | 22.1% | 24.6% | 27.6% | 31.3% | 31.3% | 31.3% | 31.3% | 31.3% | 31.3% |
| Accumulated Depreciation/Gross Plant | | 9.5% | 18.7% | 27.6% | 36.2% | 36.2% | 36.2% | 36.2% | 36.2% | 36.2% | 36.2% |

## Changing Ratio of Depreciation to Capital Expenditures to Depreciation with Changes in Growth

The calculation of the stable ratio of capital expenditures to depreciation and calculation of the stable net plant depreciation rate would be straightforward if the growth rate in capital expenditures never changed. With constant growth rates, you could apply the function developed above in the same way that working capital changes can be adjusted. However if the growth rates change, the future capital expenditures for replacing assets in part depend on the growth rate that occurred in the past. If the past growth was relatively slow and the future growth rate is relatively fast, relatively low capital expenditures are required to replace the relatively low capital expenditures that were made earlier. On the other hand if past growth was high, replacement capital expenditures are high. Consider the analogy of a country with changing population rates to demonstrate the point. Say there was a large increase in births after a war (such as the baby boom). If there is a changing attitude towards family size resulting in lower births (like the terminal growth) then it is not necessary for women to have many babies to support the growth until the baby boomer's die. On the other hand, if there is a was a trough in babies, women would have to give more births to support future growth. In the context of financial models, the pattern of past expenditures affects future required replacement of assets necessary to maintain growth.

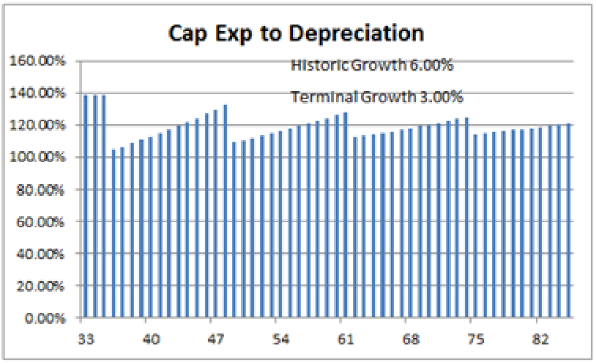
Dissecting historic data from financial statements to come up with the level of capital expenditures that supports a level of EBITDA where the growth rate changes is challenging because of the issue of past growth introduced in the last paragraph. The issue of adjusting the ratio of capital expenditures to

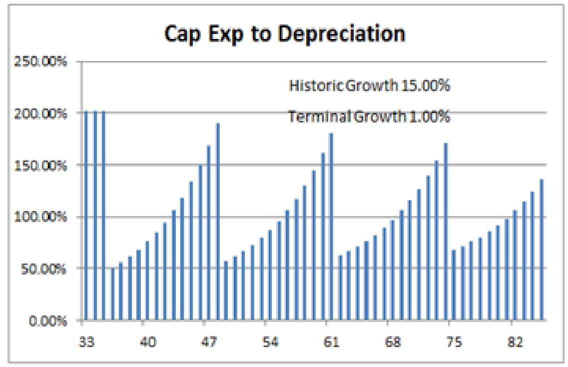
deprecation arises when computing the implied EV/EBITDA ratio where growth rates change as well as evaluating whether the value driver formula (1-g/ROIC)/(WACC-g) can be applied. To derive the historic growth rate from financial statements you can use information from historic financial statements on the ratio of accumulated depreciation to gross plant that was introduced in Part 1. A user defined function that performs a dynamic goal seek on to derive the implied growth can be developed using a FOR NEXT loop with declining STEP increments as illustrated below. You can start with a very low growth rate that implies a high ratio of accumulated depreciation and gradually increase growth rates until the target growth rate has been achieved. Once the target has been exceeded, you can try smaller STEP increments and repeat the process. Each time you exceed the target you can reduce the size of the increment until the growth increment is very small. Results of a function that derives the implied growth rate is illustrated below.

| | Historic | Modelled | Long-term | |
|---|---|---|---|---|
| Accumulated Depreciation to Net Plant | 39.57% | 42.95% | 49.65% | |
| Net Plant Depreciation Rate | 14.64% | 14.93% | 15.89% | |
| Capital Expenditures to Depreciation | 202.47% | 171.77% | 125.18% | |
| Retirements as Percent of Depreciation | 32.91% | 42.94% | 75.18% | |
| Retirements as Percent of Gross Plant | 2.53% | 3.30% | 5.78% | |
| Retirements as Percent of Net Plant | 4.19% | 5.79% | 11.48% | |
| Gross Plant Depreciation Rate | 7.69% | 7.69% | 7.69% | |
| | | | | |
| Implied Growth from User Function | 15.00% | 10.99% | 3.99% | < ---- =Growth_Find(N12,E18,3) |
| Input Growth | 15.00% | 11.00% | 4.00% | |

In thinking about problems with modelling depreciation and capital expenditures, one can imagine jumping from one platform to another platform in a warehouse. In the case of working capital, the relationship between working capital investment and growth the transition is immediate and one simply jumps to the second platform. In the case of capital expenditures, depreciation and deferred taxes the transition can take a long time – in theory it will take an entire life cycle of plant and the value depends on how on jumps for each intermediate platform. This is why it is difficult to create a simple formula for the ratio of capital expenditures to depreciation in the face of changing growth.

A problem in using financial data to derive stable depreciation and capital expenditures is that when the growth rate changes, the depreciation rate from the growth rate during the historic period continues to have an effect on the ratio of capital expenditures until all of the assets that were put in service are retired. If the assets previously grew at a rate of 30% and then only grow at 2%, in the future, capital expenditures are needed to replace the capital that was built in future years. Over the prospective life cycle of a plant (i.e. for the life of the plant after the terminal period), the level of capital expenditures required to replace the existing plant is equal to the current level of gross plant on the balance sheet. Without growth, this level of replacement capital expenditure would be flat. With a high rate of historic growth, the replacement of the fixed level of plant is skewed to the future meaning that less replacement capital expenditure occurs early on and more occurs in the later years. The graphs below illustrate the pattern of capital expenditures after a change in growth rate. When the growth declines, the capital expenditures required for increasing the size of the plant to support EBITDA growth decline, but the capital expenditures to replace old plant must still be made. The left panel of the graph shows a case with a relatively slow historic growth rate of 6% and a terminal growth rate of 3%. In this graph the pattern of historic expenditures is similar to the future expenditure and the ratio of capital expenditure to depreciation is flat. The right hand side shows a case with 15% historic growth and only 1% terminal growth. In this case the replacement capital expenditures occur later on and the pattern of future capital expenditures follows a saw-tooth pattern.




To create a practical technique that accurately measures the future capital expenditures when growth rate changes, the patterns of expenditure shown in the above graph should be reduced to a single number. One could not simply compute the average level of capital expenditure to depreciation in the above graphs, but this would not result in a correct effect on valuation. If one would like a single number to plug into terminal value calculations, the different value of future expenditures relative to current expenditures must be accounted for with a discount rate. A low discount rate near zero that implies future expenditures have a similar value as current expenditures and the time pattern that results from historic expenditures would not have much of an effect on the valuation analysis. On the other hand when the discount rate is high, the historic growth can have a more important effect on valuation.

## Mechanics of Computing the Ratio of Capital Expenditures to Depreciation that can be Directly used in Corporate Models

Creating a single function that accounts for (1) the level of capital expenditures driven by the prospective terminal growth rate; (2) the pattern of expenditures required to replace existing plant; and (3) the valuation effects of the timing of expenditures can be accomplished with the following procedure:

**Step 1: Compute the gross plant balance from changing growth rates:**

To understand how a function can be created that adjusts for historic growth it is useful to consider a simple example of how changing growth affects capital expenditures. Assume that your company makes something and you need a factory and capital to produce your product. The cost of the factory is 1000 per unit (pretend that there is no inflation). This means that if you produce a lot more, you must buy new equipment that costs 1000 per unit whilst if you grow at a slower rate you need less new equipment. If your business continues, you also must buy new equipment to replace the old equipment that has worn out and must be replaced. To think about how capital expenditures work in this context it is best to begin with the amount of capacity rather than any financial data. If you want to grow by 2% per year, then the capacity must also grow by 2% as demonstrated by the following simple equation:

$$\text{Capacity}_t = \text{Capacity}_{t-1} \times (1 + \text{growth rate})$$

The amount of new capacity however cannot be modelled by the equation $\text{Capacity}_t - \text{Capacity}_{t-1}$ because new capacity must also be purchased to replace old capacity. If you know how much capacity must be replaced, then the new capacity can be represented as:

$$\text{New Capacity} = \text{Capacity}_t - \text{Capacity}_{t-1} + \text{Retirements}_t$$

If the cost per unit of capacity remains constant then plant balance of capacity grows at the same rate as the amount of capacity. In this case the balance of the gross plant (not net plant after subtracting accumulated depreciation) grows at the same rate as the capacity. As the depreciation expense is driven by the gross plant balance (not the net plant balance), the depreciation expense grows at the same rate

as the overall plant balance. Importantly this means that the depreciation expense grows at the same rate as the overall EBITDA as long as there is no change in the relationship between EBITDA and net plant which can be represented as the return on investment. This implies that if the ratio of capital expenditures to depreciation is used to model capital expenditures, then you do not have to worry about changing the level of depreciation expense. The relationship between depreciation expense and gross is illustrated by the formulas below:

$$\text{Plant Balance}_{t} = \text{Plant Balance}_{t-1} \times (1 + \text{growth rate})$$

Because the depreciation rate does not change (assuming the same plant life), then:

$$\text{Depreciation}_{t} = \text{Depreciation}_{t-1} \times (1 + \text{growth rate})$$

**Step 2: Establish retirements from historic growth in first pass**

In coming up with a prospective ratio of capital expenditures to depreciation that applies to prospective periods, the capital expenditures are affected by the historic growth because of replacement capital expenditures. The following equations illustrate how historic retirements affect prospective capital expenditure.

$$\text{Future Capital Expenditure}_t = \text{Plant Balance}_t - \text{Plant Balance}_{t-1} + \text{Retirements}_t$$

where,

$$\text{Retirements}_t = \text{Capital Expenditure}_{t\text{-life}}$$

To compute capital expenditure associated with the prior life cycle of plant, the base level of retirements that occurred at the start of the earlier life cycle must be established. This base level of capital expenditures in the prior life cycle can be computed using a function that automates a goal seek to find a starting level of capital expenditures to accumulate to a given level of plant with inputs for the life of the plant and growth rate. Such a function named find_base is described in detail in Part 1. Once the base level of capital expenditure for the beginning of the prior life cycle is established, the capital expenditure for the remaining prior life cycle is given by a simple growth rate as demonstrated below:

$$\text{Starting Capital Expenditure}_{\text{Current period -life}} = \text{find\_base(Historic Growth Rate, Life)}$$

$$\text{Capital Expenditure from Prior Life Cycle} = \text{Capital Expenditure}_{t-1} \times (1+\text{Historic Growth})$$

As the ultimate goal is to derive the future capital expenditure to depreciation and to compute the present value of this ratio, the retirements must be established. This can be accomplished by making a function with two passes. The first pass works around one life cycle of the plant. The second pass works around the future capital expenditures and computes the present value of these expenditures over a very long period to account for the changing saw-tooth pattern of expenditures that can come from a changing growth rate.

**Step 3: Compute present value of future capital expenditures in second pass**

Once the retirements from the prior life cycle have been established, a second FOR NEXT loop can be added to compute the prospective capital expenditure and the prospective depreciation yielding the future ratio of capital expenditure to depreciation. As this ratio is not constant one can compute the present value of the ratio to derive a single value that can be applied in terminal value calculations. The present value calculation can be made over a long period of time as the level of capital expenditures follows a cyclical pattern. The second loop that includes calculation of a present value factor and derives a single value for the level of capital expenditure to depreciation is shown below.

```
Function stable_capexp(historic_growth, future_growth, Life, wacc, timing_code)

Dim cap_exp(800)                                              ' Make a long-term analysis because of changing replacement cap exp

base_retirement = find_base(historic_growth, Life)            ' Find the base level of retirements from a function

cap_exp(1) = base_retirement                                  ' First pass around history

For i = 2 To Life                                             ' First Pass to find retirements
    cap_exp(i) = cap_exp(i - 1) * (1 + historic_growth)       ' Find prior cap exp for retirements
Next i

Balance = 1                                                    ' Begin long-term loop
Starting_Balance = 1
pv_factor = (1 + wacc)

For i = Life + 1 To 500                                        ' Second pass using retirements from first round
    Balance = Balance * (1 + future_growth)

    Select Case timing_code                                   ' Different depreciation depending on method
      Case 1: Base = Starting_Balance
      Case 2: Base = (Balance + Starting_Balance) / 2
      Case 3: Base = Balance
    End Select

    Depreciation_Expense = Base / Life                         ' Depreciation from the base

    retirement = cap_exp(i - Life)                             ' Retirements from lag
    cap_exp(i) = Starting_Balance * (1 + future_growth) - Starting_Balance + retirement    ' Replace retirements and grow

    Starting_Balance = Balance                                 ' retain opening balance

    pv_factor = pv_factor * (1 + wacc)                         ' Accumulate PV factor for valuation
    pv_cap_exp = pv_cap_exp + cap_exp(i) / pv_factor           ' Compute the PV of cap exp over the second loop
    pv_dep = pv_dep + Depreciation_Expense / pv_factor         ' Compute the PV of depreciaiton over the second loop

Next i

stable_capexp = pv_cap_exp / pv_dep                            ' Final value of function

End Function
```

## Implementing the Stable Ratio of Capital Expenditures to Depreciation in Valuation Analysis

One of the good things about developing a user-defined function is that once you have made the function one time you can use it in all of your models. To re-use the function you can simply copy the code into your model or create an add-in with an XLA file that you can incorporate into your excel program. The function accepts historic growth, terminal growth, WACC, and plant life and gives you a single value for the ratio of capital expenditures to depreciation.

To illustrate the effect of modelling the capital expenditures in the terminal period with different formulas and different growth rates, the two tables below illustrate the effects of four different potential methods of dealing with capital expenditures. The first method is develops a long-term theoretical analysis where the company begins with stable ratios of capital expenditures to depreciation, accumulated depreciation to gross plant and other factors driven by historic growth. The company is then assumed to experience a sudden change in the growth rate. Techniques to build up the plant balances and depreciation expense for a long-term theoretical analysis are described in Part 1 in relation to depreciation analysis. After the change in growth rate, EBITDA, plant balances, depreciation and return grow at the lower growth rate (capital expenditures, net plant and return on investment do not grow at the constant rate). The value of EBITDA net of capital expenditures after the change in growth rate establishes the theoretically true value of the company.

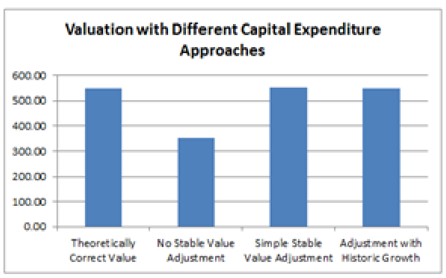
Once the true value of the corporation is established, three additional techniques of modelling capital expenditures are compared to this theoretical value. The first method does not make any adjustment for stable ratios and simply applies the last year of capital expenditure in computing the terminal value. Using this method, the level of capital expenditure does not change when the capital expenditure changes. Cash flow from the terminal period is simply converted to value using the standard (1+g)/(WACC-g) formula. The second method applies a stable ratio of capital expenditures to depreciation, but makes no adjustment for historic growth. This method uses the function described at

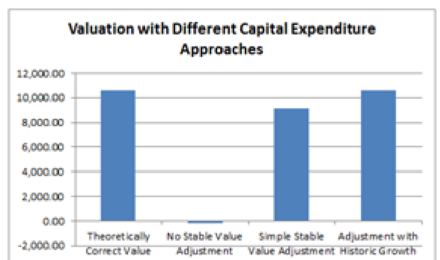
the beginning of this chapter that computes the stable value of capital expenditures to depreciation but does not extend the analysis for historic growth. The value is computed through multiplying the depreciation in the terminal period by the stable ratio and then applying the (1+g)/(WACC-g) to the adjusted cash flow. The third and final method is the same as this method except that the adjusted stable ratio that a different ratio of capital expenditures to depreciation is applied. This method uses the present value of capital expenditures relative to depreciation after accounting for historic growth that drives the time pattern of prospective asset retirements.

As with the graphs of prospective capital expenditure, the effects of applying different methods to adjust capital expenditures are demonstrated with two different assumptions with respect to historic and future growth. The left table shows the four different capital expenditure methods assuming a relatively slow historic growth rate of 6% and a terminal growth rate of 3% that is not too different from the historic growth rate. The right hand table shows the valuations with alternative capital expenditure assumptions using a case with 15% historic growth and only 1% terminal growth. In this case on the left with similar historic and terminal growth rates all methods are reasonably accurate although the case with no adjustment for growth understates value by 35%. The case that accounts for historic growth correctly values the corporation because it applies essentially the same formulas as used in the theoretically true model. The table on the right shows that making the adjustment is crucial when the growth rate changes by a large margin. Without any adjustment for the new lower growth rate, the capital expenditures are far too high which understates valuation by more than 100%. In the case that does not consider historic growth but does include future growth, the value is understated by 13.5%. Further sensitivity analysis demonstrates that the effect of the adjustment is more when the asset life is long than when the asset life is short.

| | Cap Exp to Dep Ratio | Value | Percent Difference from True Value |
|---|---|---|---|
| Theoretically Correct Value | | 546.41 | |
| No Stable Value Adjustment | 138.54% | 352.61 | -35.5% |
| Simple Stable Value Adjustment | 118.68% | 549.06 | 0.5% |
| Adjustment with Historic Growth | 115.61% | 546.42 | 0.0% |

| | Cap Exp to Dep Ratio | Value | Percent Difference from True Value |
|---|---|---|---|
| Theoretically Correct Value | | 10,598.94 | |
| No Stable Value Adjustment | 202.47% | -189.23 | -101.8% |
| Simple Stable Value Adjustment | 106.08% | 9,165.05 | -13.5% |
| Adjustment with Historic Growth | 89.78% | 10,598.94 | 0.0% |




# Chapter 30: Computing a Stable Ratio of Deferred Tax Changes to Capital Expenditures in a Similar Manner to the Stable Ratio of Capital

Analysts tend to be a little intimidated by deferred taxes which sometimes results in large mechanical errors. With a bit of patience one can work through the deferred taxes and develop reasonable estimates for valuation. As explained above when discussing the bridge between enterprise value and equity value, deferred taxes associated with accelerated depreciation that arise because of capital expenditures must be directly included in the calculation of free cash flow and not in the bridge between enterprise value and equity value. Where increases in deferred tax liability are added to the free cash flow, value is increased while if accumulated deferred taxes are classified as debt like, the value is decreased. Furthermore, other deferred tax items that are associated with operations such as warranty provisions should also be part of the free cash flow analysis. In the case of deferred taxes associated with acceleration of depreciation, if the tax depreciation is greater than the book depreciation meaning that taxes paid are less than taxes booked, the change in deferred tax liability results in increased free cash flow. Instead of the simple free cash flow calculation that includes EBITDA, capital expenditures and working capital changes, a more careful calculation of free cash flow should be something like:

Free Cash Flow =
EBITDA - WC Change - Capital Expenditures +
Deferred Tax Changes Associated with Accelerated Depreciation +
Change in Warranty Provisions associated with EBITDA +
Deferred Tax Changes Associated with Provisions

Stable ratios for incorporating changes in deferred taxes can be computed in a similar manner as the rate of capital expenditures to depreciation. From an accounting standpoint, deferred tax represents a liability would be subtracted from enterprise value as the tax depreciation will be less than the book depreciation in the future. The accumulated deferred tax on the balance sheet contains the nominal value of the liability that would be repaid if there were no more capital expenditures or if the tax life equalled the book life. If the company keeps growing, the new capital expenditures will continue to generate new deferred taxes and a stable rate of new deferred taxes to can be computed in a similar manner as the ratio of capital expenditures to depreciation discussed above. As with book depreciation, an investment balance is set up for the deferred taxes instead of the book taxes. The difference between the tax deprecation and the book depreciation multiplied by the tax rate yields the change in deferred tax that should be added to free cash flow.

In computing the deferred taxes over the explicit modelling period, the deferred taxes associated with existing plant should be separated from deferred taxes associated with new plant as is the case for depreciation expense. The challenge for this calculation is deciphering the amount of deferred taxes associated with existing plant from information in financial statements. When modelling the terminal value, a stable ratio of deferred tax change relative to capital expenditures can be derived in a similar manner as the stable ratio of capital expenditures to depreciation was established. In coming up with this stable ratio of deferred tax change to capital expenditures, the ratio is influenced both by the future terminal growth rate and the historic growth rate as is the ratio of capital expenditures to depreciation. The process of computing the ratio can be described by beginning with a case where the growth rate does not vary between the explicit modelled period and the terminal period. Once the stable ratio in the constant growth case is established, the effects of changes in growth rate between the historic period and the terminal period can be incorporated which requires working through a historic lifecycle in using a discount rate to establish a single terminal value for the change in deferred taxes relative to capital expenditure.

If the growth rate does not change, the calculation of stable deferred tax to capital expenditure (which measures how much deferred taxes reduce the effective amount paid for capital investments) is fairly straightforward. As with the ratio of capital expenditures relative to depreciation, the ratio of deferred tax change to capital expenditures stabilises over the life cycle of an plant investment when the growth rate is constant. This ratio measures the effective amount that the capital expenditures are reduced because of the advantageous tax depreciation. To compute the ratio, you can make a long-term financial model as is the case for the other corporate modelling issues discussed in this part of the book. Alternatively you can create user defined function that makes the calculation automatically. When computing the stable ratio using a constant growth rate assumption, you need to input both the tax an book depreciation rates as well as the tax rate. The excerpt from the model below illustrates how the ratio of deferred tax to capital expenditure stabilises at a constant 15.57% percent after a life cycle which implies that the tax depreciation reduces the cost of the capital by 15.57% compared to a case where the tax depreciation is equal to the book depreciation. This ratio is high because the tax life is short; a double declining balance method for tax deprecation is applied; the income tax rate is high; and the growth rate is high. The tax depreciation is computed using the deprecation function described in Part 1. Deferred tax changes are the difference between book and tax depreciation multiplied by the tax rate.

| **Assumptions** | | **Outputs** | |
|---|---|---|---|
| Growth | 20.00% | Change in Deferred Tax/Cap Exp | 15.57% |
| Book Life | 10 | Cap Exp/Depreciation | 198.77% |
| Tax Rate | 50% | | |
| Timing Code | 3.00 | | |
| Tax Life | 5 | | |
| Decline Factor | 2.00 | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tax Depreciation Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Depreciation Rate | | 40.00% | 24.00% | 14.40% | 10.80% | 10.80% | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Period | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Capital Expenidture | 100.00 | 120.00 | 144.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | 515.98 | 619.17 | 743.01 | 891.61 |
| Plant Balance | | | | | | | | | | | | | |
| Opening Balance | | 100.00 | 220.00 | 364.00 | 536.80 | 744.16 | 992.99 | 1,291.59 | 1,649.91 | 2,079.89 | 2,595.87 | 3,115.04 | 3,738.05 |
| Add: Capital Expenditure | 100.00 | 120.00 | 144.00 | 172.80 | 207.36 | 248.83 | 298.60 | 358.32 | 429.98 | 515.98 | 619.17 | 743.01 | 891.61 |
| Less: Retirements | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 100.00 | 120.00 | 144.00 |
| Closing Balance | 100.00 | 220.00 | 364.00 | 536.80 | 744.16 | 992.99 | 1,291.59 | 1,649.91 | 2,079.89 | 2,595.87 | 3,115.04 | 3,738.05 | 4,485.66 |
| Book Tax Depreciation | 10.00 | 22.00 | 36.40 | 53.68 | 74.42 | 99.30 | 129.16 | 164.99 | 207.99 | 259.59 | 311.50 | 373.81 | 448.57 |
| Tax Depreciation using Function | 40.00 | 72.00 | 100.80 | 131.76 | 168.91 | 202.69 | 243.23 | 291.88 | 350.26 | 420.31 | 504.37 | 605.24 | 726.29 |
| Difference | 30.00 | 50.00 | 64.40 | 78.08 | 94.50 | 103.40 | 114.07 | 126.89 | 142.27 | 160.72 | 192.86 | 231.44 | 277.72 |
| Change in Deferred Tax | 15.00 | 25.00 | 32.20 | 39.04 | 47.25 | 51.70 | 57.04 | 63.44 | 71.13 | 80.36 | 96.43 | 115.72 | 138.86 |
| Deferred Tax/Cap Exp | 15.00% | 20.83% | 22.36% | 22.59% | 22.79% | 20.78% | 19.10% | 17.71% | 16.54% | 15.57% | 15.57% | 15.57% | 15.57% |
| Cap Exp/Depreciation | | 5.4545 | 3.9560 | 3.2191 | 2.7865 | 2.5059 | 2.3119 | 2.1717 | 2.0673 | 1.9877 | 1.9877 | 1.9877 | 1.9877 |

The ratio computed in the above excerpt can be computed through making a user-defined function that works through the life cycle of a plant investment just like the case with the function for computing capital expenditures to depreciation. This function must compute depreciation twice and repeat the function for depreciation that includes the vintage analysis. You also need to input both the book depreciation life and the tax depreciation rate. Including the vintage depreciation is explained below in the context of the case where historic growth is included in the analysis. Without accounting for historic growth, the ratio of deferred tax to capital expenditure is a function of the tax rate, the tax life, the type of tax depreciation (double declining balance etc.) and the growth rate. Assuming a growth rate of 5%, a tax rate of 30% a book life of 20 years, the table below shows the stable ratio that results from different tax lives and depreciation methods. This analysis demonstrates that the method of deprecation ranging from triple declining balance to straight line does not make much of a difference compared to the tax life when the tax life is relatively short. The table also demonstrates that the ratio of deferred tax change to capital expenditures stabilises at a relatively low percentage.

| Book Life | 20 | Growth | 5.00% | Tax Rate | | 30.00% |
|---|---|---|---|---|---|---|
| **Stable Ratio of Deferred Tax Increase to Capital Expenditure** | | | | | | |
| | | Declining Balance Factor | | | | |
| | | 1.00 | 1.50 | 2.00 | 2.50 | 3.00 |
| Tax Life | 1 | 10.37% | 10.37% | 10.37% | 10.37% | 10.37% |
| | 2 | 9.66% | 10.01% | 10.37% | 10.37% | 10.37% |
| | 4 | 8.30% | 8.69% | 9.16% | 9.58% | 9.91% |
| | 6 | 7.02% | 7.48% | 8.07% | 8.61% | 9.04% |
| | 8 | 5.82% | 6.36% | 7.06% | 7.70% | 8.23% |
| | 10 | 4.70% | 5.29% | 6.10% | 6.84% | 7.47% |
| | 14 | 2.64% | 3.36% | 4.36% | 5.27% | 6.04% |
| | 16 | 1.71% | 2.48% | 3.56% | 4.55% | 5.38% |
| | 18 | 0.83% | 1.64% | 2.80% | 3.86% | 4.75% |
| | 20 | 0.00% | 0.86% | 2.08% | 3.20% | 4.15% |

The idea of recording tax as a liability is that the lower amount of taxes that were paid because of things like accelerated tax depreciation will reverse one day in the future. If capital expenditure stops, the deferred taxes will become negative and the liability will be paid through actual taxes paid that are higher than book taxes. This general idea of deferred taxes reversing is important when growth rates change. If the growth rate during the explicit period was 30% and it becomes -5%, the capital expenditures have not stopped, but something not so very different has happened. The prospective cash flow should account for the reversal of deferred tax from the high growth period as well as the new deferred taxes generated from the on-going growth. To account for this you need to put the historic growth rate into the analysis just like the case for capital expenditures. Then you can work through two life cycles and compute the present value of the prospective deferred tax changes as well as the capital expenditures. Once you have this function created, you can add it to your models just like the case for capital expenditures.

The function below demonstrates the second part of the function that creates a stable ratio of deferred tax to capital expenditures. As with the other functions, the idea is that you can create add the function to any of your corporate models and develop a more accurate terminal value. The function will also be used in the development of the implicit EV/EBITDA multiple.

# Chapter 31: Terminal Value in the Context of Philosophy Regarding the Ability to Earn Returns above the Cost of Capital in the Long-Run and the Problem of Assuming Companies will Stay in Business While Not Earning Any Economic Profit

Economic profit is the generated when a business entity earns a return above the opportunity cost of capital that reflects the risk of the business. If economic profit is earned, the investment made by investors increases in value. Whether managers know it or not, their most fundamental objective is to earn such an economic profit. Following from this, any financial model that makes a valuation implicitly measures the ability of a firm to earn an economic profit in the short-term and the long-term. For business enterprises operating in a competitive environment, earning an economic profit is difficult and companies are certainly not always able to earn a return above their cost of capital. But if a business cannot earn a return on invested capital that exceeds the WACC, they will have to exit the business or be forced to exit in one way or another. The next two chapters address different ways to explicitly account for variances in economic profit in a the terminal value section of a corporate financial model.

The discussion of stable ratios in the previous two chapters, the return on invested capital was not an explicit part of the analysis. But that does not mean it was not an implicit assumption. As emphasised at the beginning of this part of the book, one of the best ways to review if your model makes sense is to make a graph of the return on invested capital and ask difficult questions about whether the return is reasonable. By the time that your forecast reaches the stable period, the underlying philosophy of stable

periods implies that the return should be stable. If your model does not have an explicit assumption for the return on invested capital relative to the WACC it does not mean that you have not made such an assumption.

### Myth of Convergence of Return on Capital and Cost of Capital

The discussion of growth made it seem as if a company can grow, then the value will increase. While the growth formula does apply two key factors that drive value – the growth rate and the cost of capital – it does not account for the third factor which is the rate of return on capital. The rate of return on capital can change the way growth rate affects value. Using the growth rate formula makes it appear as if growth is always good for investors, which is not the case. If a company is earning below its cost of value. Indeed, if a company is earning a return below its cost of capital it is better to have lower (or negative) growth. The implication that the growth rate only matters if the return is above the cost of capital means that the return relative to the cost of capital should explicitly or implicitly be a consideration in computing terminal value. To illustrate this idea, consider a very simple example where a company re-invests a portfolio of risk free treasury bills. The initial investment in a company is 100 and the return is 2% after the company wastes money on administrative costs. To finance the company, bank loans at a borrowing rate of 5% are made which is the same rate that investors could make if they invested in the treasury bills themselves. Thus, the return of 2% is below the cost of capital of 5%.

If the earned return is equal to the cost of capital, then the growth rate does not affect the value to investors as the company is doing nothing to either add or destroy value. This means that to resolve problems with wide variation in terminal value driven by growth rates, one can attempt to take the growth rate out of the process by assuming that the rate of return equals the cost of capital. If the return is equal to the cost of capital, then the value does not change whether the growth rate is 10% or -5%. All one has to do is to make a seemingly sensible assumption that over the long-run, competition will push returns down to the cost of capital as products become more commoditized.

While one can make general arguments that the return driven by competitive advantage will converge to the cost of capital, the idea that rate of return will decline to the cost of capital is more difficult to accept than the idea that companies will stop growing. If a company cannot earn more than its cost of capital, it should not be in business and it should not make new investments. The fact that the market to book ratio of companies is substantially above one is evidence that the companies do realize a rate of return above their cost of capital. From an economic perspective, one can make the argument that competition will drive returns to the cost of capital in competitive and mature industries where there is little differentiation in products. However even in these circumstances it makes little sense to assume that company will make new investments without expecting some kind of economic profit. On the other hand, if a company is currently earning returns far above its cost of capital it is not reasonable to assume that such profit can last indefinitely. Companies can copy products, management techniques, marketing strategies and cost structures which temporarily allow some companies to realize extraordinary returns.

When inspecting mature companies, it is more difficult to find a consistent trend where the return on capital converges to the cost of capital than to find evidence of declining growth rates. (It is also tricky to compute the return on capital after the company experiences a large write-off for goodwill or asset impairment as the subsequent investment balance declines and the balance sheet no longer represents invested capital.) Many mature large companies can be observed and it is quite rare to find companies that are just earning their cost of capital and have a return on capital similar to the cost of capital. Some argue that finding evidence of declining returns is again challenging because of survivorship bias in the statistical analysis, meaning that companies where returns fall go bankrupt and stop producing things and one cannot find long-term trends for these companies. Others argue that when companies become big, they are very careful to only make investments where the return is above the cost of capital. As with the survivor ship bias argument involving growth rates, this argument is impossible to ever resolve as, by definition, the data to prove the case does not exist. One is left with philosophy.

Despite difficulties in making the assumption that returns will suddenly converge to the cost of capital, a few points general points about the relationship between returns and the cost of capital can be considered:

1. When a company is earning a very high return on invested capital, it is reasonable to assume the return will begin converging to the cost of capital although it is not at all reasonable from a philosophical perspective that the return will completely converge to the cost of capital.

2. When constructing a financial model, one should be very suspicious of projected returns that are substantially above the historic returns. This implies that computing returns on equity and returns on invested capital after the financial statements are developed should be a standard part of the modelling process.

3. When evaluating returns it is often better to use the return on invested capital rather than the return on equity because the return on equity can be distorted by changes in historic or future capital structure.

# Chapter 32: Is the Value Driver Formula a Solution to All of these Problems or is it a Black Box Containing Many Implicit Assumptions that Are Almost Impossible to Dissect

A formula referred to in this chapter as the value driver formula explicitly considers both the growth rate and the prospective return that can be applied to income. This formula which is (1-growth/return)/(cost of capital – growth), can simulate the possible convergence in returns to cost of capital over the long-term and is popular with some technicians. As the value driver formula considers returns, risks and growth it seems to solve problems inherent with both the stable growth rate method and the use of simple valuation multiples. The biggest difference between the stable growth method discussed in the last couple of chapters and the value driver formula is that you seemingly can make an explicit assumption with respect to the cost of capital. The standard growth rate formula FCFF/(WACC-g) implicitly assumes that the return on investment that exists in the terminal period will approximately continue (the return does not stay precisely the same because the net plant does not grow at the same rate as the gross plant).

This chapter presents a critical analysis of the value driver formula and demonstrates that the formula is not the nirvana that can solve all of your valuation problems. Instead, the formula contains biases and implicit assumptions that leave it all but useless if you are careful in making valuations. Some of the problems with the value driver formula include:

- The manner in which the realised return converges to the incremental return is not logical and does not incorporate the replacement of existing assets.

- When the EBITDA growth rate changes and the working capital necessary to support the EBITDA growth changes along with the EBITDA, the formula does not result in the correct valuation.

- Depreciation on existing assets is not accounted for correctly which causes the formula to incorrectly value the investment.

- Capital expenditures that are made to support EBITDA growth result in earnings that do not grow at the same rate as investment leading to valuation that exceeds the value of cash flow.

### Deriving the Value Driver Formula in the Case of the P/E Ratio and Equity Earnings

To assess the usefulness of the value driver formula it is useful to begin by working through derivation of the formula. In explaining how the value driver formula works, one can begin with an equity perspective

that establishes the formula for the P/E ratio using ROE, cost of equity, growth in earnings and the level of earnings. Once the formula for the P/E is established, an analogous formula can be developed for the EV/EBITDA multiple using the ROIC and the WACC. While the formula for enterprise value is more useful in computing terminal value, the formula for equity value with ROE, growth and cost of equity is more convenient in explaining the basis of the equation.

To understand the value driver formula driven by rate of return, growth and cost of capital, you can begin with the dividend discount model where the price of a stock price is determined by the cost of capital along with an estimate of the growth rate in dividends. By assuming that marginal investors believe the growth rate in dividends is constant forever, one can establish the well-known dividend discount equation for computing the value of a share. The value of a share is the next anticipated dividend divided by the difference in the cost of equity and the growth rate in dividends (the mathematics of the formula requires using the next year cash flow rather than the current period dividend):

$$P_0 = D_1/(k-g)$$

When combining this formula with the sustainable growth rate formula, you can easily prove the value driver formula. The sustainable growth formula for dividends is dependent on the rate of return and the dividend payout ratio. If all earnings are re-invested implying a zero dividend payout ratio, then the equity balance grows by the return on equity which means that dividends also grow by the return on equity. On the other hand, when the dividend payout ratio is 100%, none of the income is re-invested and the growth rate is zero. The growth rate is a function of the return on equity and the payout ratio as reflected in the sustainable growth rate formula:

$$\text{Sustainable growth} = \text{ROE} \times (1\text{-dividend payout})$$

This formula can be re-arranged (and is much more useful) when the dividend payout ratio is computed as a function of growth. In real companies it is the growth rate opportunities or lack thereof that drives dividends and not the other way around. The formula for the dividend payout ratio becomes:

$$\text{Dividend Payout} = 1 - \text{Sustainable growth/ROE}$$

Since dividends equal the dividend payout ratio multiplied by the dividend per share, the dividends can be expressed as:

$$D_1 = (1-g/ROE) \times EPS_1$$

By substituting the formula for dividends, the value and the P/E ratio can be expressed in terms key value drivers – the ability to earn more than the cost of capital and the ability to grow that difference. By substituting the formula for $D_1$ into the formula for the current price, the price of the share becomes:

$$P_0 = EPS_1 \times [1-g/ROE] /[k-g]$$

The above formula demonstrates that value is directly related to the current level of earnings. This means that the value depends on both the current level of return as well as the future growth rate and the rate of return. For example, if two companies have the same level of investment, the same cost of capital, and the same future return and growth but different levels of earnings, the valuation will directly depend on the difference in the rate of return earned on current earnings.

If the earnings are divided by the price of the share, then the forward P/E ratio can also be defined through simply dividing the price by the earnings in the above equation:

$$P_0/EPS_1 = [1-g/ROE]/[k-g]$$

## Deriving Implicit Assumptions about the Progression of the Incremental ROE in the Value Driver Formula using the Equity Perspective

The tricky part about the formula is what happens to value when you change the growth rate and/or the rate of return. Analysts who think they are fancy will tell you tell you in that you need to understand that the rate of return in the value driver formula is the incremental return on new investments and the formula does not assume that the return suddenly falls to the return assumed in the formula. To see what these people mean, you can look at the formula developed above on a gross basis instead of on a per share basis.

$$\text{Equity Value}_0 = \text{Net Income}_1 \text{ x } [1\text{-g/ROE}] /[\text{k-g}]$$

One part of the confusion around the value driver formula comes about because the return on equity inherent in the Net $\text{Income}_1$ is not necessarily the same as the ROE in the right hand side of the equation. The 1-g/ROE term drives future dividend growth where the ROE is the return on new investments, but this is not the same as the ROE inherent in current income. To see this more clearly, net income can be defined as existing ROE multiplied by existing investment and the ROE in the formulas above can be defined as the incremental ROE. The equation is now:

$$\text{Equity Value} = \text{ROE}_1 \text{ x Current Equity x } [1\text{-g/Incremental ROE}]/(\text{k-g})$$

If the cost of capital is currently below the return on capital and the return on capital is the incremental cost of capital, then some argue that the formula results in assuming that the existing assets earn the current return while new investments earn an incremental return. Further, as demonstrated below, if the return on new investments is assumed to be the same as the cost of capital, then the formula implicitly removes the effect of growth from the terminal value and the value of the company is more dependent on the ability of exiting assets to earn an economic profit.

To understand implications of the value deriver formula you can create a theoretical analysis where investment is divided between the existing investment and new investment. The existing investment is assumed to earn the initial rate of return and the new investment earns the incremental return. Dividends that represent cash flow to investors can be computed from the weighted average return on equity and the assumed growth as illustrated by the formula below.

Total Equity Investment = Current Equity x (1+Growth Rate)

New Equity Investment = Total Equity Investment - Current Equity

$$\text{Total Income} = \text{ROE}_1 \text{ x Current Equity x Incremental ROE x New Equity Investment}$$

$$\text{Weighted ROE} = \text{ROE}_1 \text{ x Current Equity x Incremental ROE x New Equity}$$

Dividends = Total Return - Required Incremental Investment

To illustrate how the value driver formula works, the first excerpt below shows a case where the incremental return equals the existing return. In this case, the valuation derived from the value driver formula equals the theoretical valuation. The equivalence demonstrates the validity of the example.

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assumptions** | | | | | | | | | | | | | |
| Current ROE | 15% | | Growth Rate | | | 2% | | | PE - Theory | | 10.83 | | |
| Incremental ROE | 15% | | Cost of Equity Capital | | | 10% | | | PE- Value Driver | | 10.83 | | |
| **Model** | | | | | | | | | | | | | |
| Period | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Book Value | | 10.00 | 10.20 | 10.40 | 10.61 | 10.82 | 11.04 | 11.26 | 11.49 | 11.72 | 11.95 | 12.19 | 12.43 |
| Initial Investment | | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Balance of New Investment | | 0.00 | 0.20 | 0.40 | 0.61 | 0.82 | 1.04 | 1.26 | 1.49 | 1.72 | 1.95 | 2.19 | 2.43 |
| Incremental Investment | | | 0.20 | 0.20 | 0.21 | 0.21 | 0.22 | 0.22 | 0.23 | 0.23 | 0.23 | 0.24 | 0.24 |
| Return on Initial Investment | 15% | | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Return on New Investment | 15% | | 0.00 | 0.03 | 0.06 | 0.09 | 0.12 | 0.16 | 0.19 | 0.22 | 0.26 | 0.29 | 0.33 |
| Total Return | | | 1.50 | 1.53 | 1.56 | 1.59 | 1.62 | 1.66 | 1.69 | 1.72 | 1.76 | 1.79 | 1.83 |
| Weighted Return | | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% | 15.00% |
| Dividends | | | 1.30 | 1.33 | 1.35 | 1.38 | 1.41 | 1.44 | 1.46 | 1.49 | 1.52 | 1.55 | 1.58 |
| | | | | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |
| **Valuation** | | | | | | | | | | | | | |
| **Value - Theory** | **16.25** | | <---- =NPV(J5,20:20) | | | | | | | | | | |
| **Value - Driver Formula** | **16.25** | | <---- =(1-Growth_Rate/Incremental_ROE)/(Cost_of_Equity_Capital-Growth_Rate)*initial_return | | | | | | | | | | |
| Percent Difference | 0.00% | | | | | | | | | | | | |

When the incremental return is different from the current return, the value driver formula is not precisely equal to the theoretically correct value. A changing return means that the growth rate in dividends cannot be equal to the growth in investment. The excerpt below shows that if the ROE declines from 20% to 12% and the growth rate is 5%, the value driver formula overstates the value by more than 6%. If the existing investment is assumed to decline rather than to stay flat, the difference would be even greater. This exercise demonstrates that the value driver formula does not produce a correct valuation.

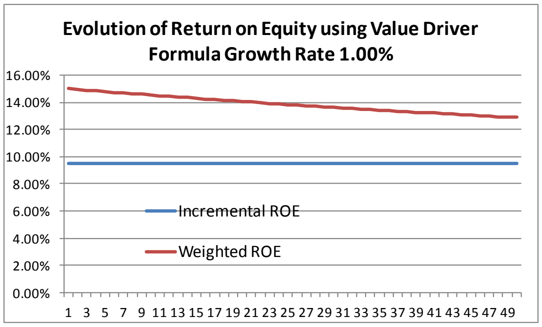
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assumptions** | | | | | | | | | | | | | |
| Current ROE | 20% | | Growth Rate | | | 5% | | | PE - Theory | | 11.00 | | |
| Incremental ROE | 12% | | Cost of Equity Capital | | | 10% | | | PE- Value Driver | | 11.67 | | |
| **Model** | | | | | | | | | | | | | |
| Period | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Book Value | | 10.00 | 10.50 | 11.03 | 11.58 | 12.16 | 12.76 | 13.40 | 14.07 | 14.77 | 15.51 | 16.29 | 17.10 |
| Initial Investment | | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| Balance of New Investment | | 0.00 | 0.50 | 1.03 | 1.58 | 2.16 | 2.76 | 3.40 | 4.07 | 4.77 | 5.51 | 6.29 | 7.10 |
| Incremental Investment | | | 0.50 | 0.53 | 0.55 | 0.58 | 0.61 | 0.64 | 0.67 | 0.70 | 0.74 | 0.78 | 0.81 |
| Return on Initial Investment | 20% | | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Return on New Investment | 12% | | 0.00 | 0.06 | 0.12 | 0.19 | 0.26 | 0.33 | 0.41 | 0.49 | 0.57 | 0.66 | 0.75 |
| Total Return | | | 2.00 | 2.06 | 2.12 | 2.19 | 2.26 | 2.33 | 2.41 | 2.49 | 2.57 | 2.66 | 2.75 |
| Weighted Return | | 20.00% | 20.00% | 19.62% | 19.26% | 18.91% | 18.58% | 18.27% | 17.97% | 17.69% | 17.41% | 17.16% | 16.91% |
| Dividends | | | 1.50 | 1.54 | 1.57 | 1.61 | 1.65 | 1.69 | 1.74 | 1.78 | 1.83 | 1.89 | 1.94 |
| | | | | 2.33% | 2.39% | 2.46% | 2.52% | 2.58% | 2.64% | 2.70% | 2.76% | 2.82% | 2.88% |
| **Valuation** | | | | | | | | | | | | | |
| **Value - Theory** | **22.00** | | <---- =NPV(J5,20:20) | | | | | | | | | | |
| **Value - Driver Formula** | **23.33** | | <---- =(1-Growth_Rate/Incremental_ROE)/(Cost_of_Equity_Capital-Growth_Rate)*initial_return | | | | | | | | | | |
| Percent Difference | 6.06% | | | | | | | | | | | | |

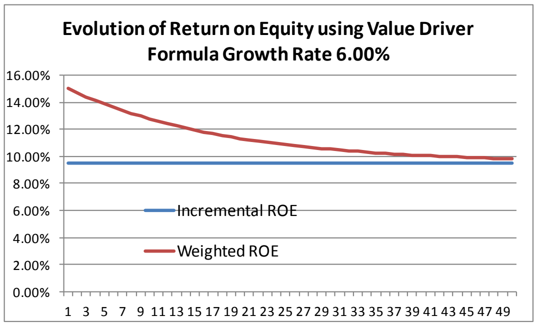
The error from applying the value driver formula depends on the growth rate assumption and the difference between the current return and the future return. If the growth rate is zero or if the difference between the current return and the incremental return is zero, there is no error. The table below demonstrates the error that results from applying the value driver formula where a positive percent implies that the value driver overstates value.

**Percent Difference Between Measured Value and Theoretical Value**

| Incremental Return | Growth -2.00% | 0.00% | 2.00% | 4.00% | 6.00% | 8.00% |
|---|---|---|---|---|---|---|
| 24.00% | 2.20% | 0.00% | -2.48% | -5.30% | -8.54% | -11.90% |
| 22.00% | 1.01% | 0.00% | -1.19% | -2.60% | -4.30% | -6.02% |
| 20.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.41% |
| 18.00% | -0.79% | 0.00% | 1.01% | 2.34% | 4.17% | 7.26% |
| 16.00% | -1.32% | 0.00% | 1.74% | 4.17% | 7.76% | 14.06% |
| 14.00% | -1.48% | 0.00% | 2.04% | 5.04% | 9.89% | 19.45% |
| 12.00% | -1.13% | 0.00% | 1.63% | 4.17% | 8.70% | 19.39% |
| 10.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.20% |
| 8.00% | 2.46% | 0.00% | -3.85% | -10.71% | -26.47% | -100.00% |

If there is positive growth, the weighted average return gradually converges to the incremental return. The manner in which the ROE gradually converges to the incremental ROE with different growth rates is illustrated in the two graphs below. In the first case that assumes 1% growth, the ROE remains more than 200 basis points above the incremental ROE after 50 years. With 6% growth, the weighted return converges much faster as more of the equity consists of the new equity.




Some people would be quite satisfied with these graphs and explain how the marginal rate of return on investments should drive value. Further, as the weighted average return does not suddenly decline to the incremental return, the formula seems to result in a reasonable transition period. Supporters of the value driver formula would insist that you just have to get into your head the difference between the marginal return and the existing return. In the extreme, if there is no growth, then the incremental return in irrelevant because the incremental return only applies to new investment. This is demonstrated by putting a zero growth in the formula and showing that the incremental return falls out:

$$\text{Equity Value} = \text{ROE}_1 \times \text{Current Equity} \times [1\text{-}0/\text{Incremental ROE}]/(k\text{-}0)$$

$$\text{Equity Value} = \text{ROE}_1 \times \text{Current Equity} \times /k$$

The zero growth case conflicts with the consumer behaviour principles that are behind the formula. Products are supposed to have a life cycle and competitive pressure is supposed to push down returns. This conflicts with the idea that if there is no growth, the return can be protected. The implicit assumption is that the existing investment somehow is insulated from pressures to converge to incremental return forever. If you somehow believed that existing investments can continue to earn their existing rate of return in face of competitive pressure (which is very odd), you are also assuming that the existing assets are some sort of thing that never dies or that these assets can be replaced and continue to earn their return forever which suggests no plant life cycle nor any competitive pressure.

In practice, more people probably care about the weighted average ROE than the incremental ROE. If you owned a factory that makes portable telephones and your telephones fell out of favour, you would not care about some kind of incremental ROE on hypothetical new investments in new factories that you have not built yet. You would care about your existing investment. Similarly, if you owned a food business and the margins a squeezed by increasing costs of inputs, it is not the marginal return on new investments that is causing the problem. Instead, you are interested in the progression of the overall return on your equity investment.

The equity case demonstrates a few serious problems in applying the value driver formula. First, the formula does not correct valuation if the return on new investments is different from the return on existing assets. Second, the manner in which the rate of return changes over time is not logical. If the growth rate is lower, the competitive advantage that results in a high return may be disappearing faster and perhaps the convergence from current return to incremental return should be faster instead of slower. In either case, the time it takes to converge is relatively long and there is no flexibility to adjust the time frame for moving the convergence of the rate of return. There is no economic theory that suggests returns on existing investments can be maintained (without some kind of contract) and there is no economic theory that implies that low growth companies can maintain returns for longer periods of time than firms that grow more quickly. The graphs demonstrate that the reason for lower variability in returns is Finally, the length of time for the returns to converge do not account for depreciation and aging of existing assets.

### Deriving the Value Driver Formula in the Case of the EV/EBITDA Ratio and Return on Invested Capital

The value driver formula applied in developing free cash flow is similar to the one derived above using equity returns and growth in income except that NOPLAT replaces EPS, WACC replaces the cost of capital and the growth in invested capital replaces the growth in equity capital. When applying this formula, the current level of return implied in the existing NOPLAT generally has a different value than the incremental ROIC in the formula. To understand development of the formula, begin with the formula for free cash flow derived from NOPLAT as follows:

$$\text{Free Cash Flow} = \text{NOPLAT} + \underbrace{\text{Depreciation} - \text{Capital Expenditures} - \text{WC Changes} + \text{Deferred Tax}}_{\text{Growth in Invested Capital}}$$

As invested capital -- net plant assets plus working capital less accumulated deferred tax -- grows by capital expenditures and working capital changes and declines by deferred tax changes and depreciation, the above formula for free cash flow can be re-written as:

Free Cash Flow = NOPLAT - Growth in Invested Capital

Since the NOPLAT can be expressed as the current return multiplied by the invested capital, and inversely, the Invested Capital = NOPLAT/ROIC, the free cash formula can be further re-stated as:

Free Cash Flow = ROIC x Invested Capital + g x Invested Capital, or

Free Cash Flow = NOPLAT + g x NOPLAT/ROIC, or

Free Cash Flow = NOPLAT x (1 + g/ROIC)

Given that NOPLAT grows by the growth rate in invested capital if the ROIC remains constant, the enterprise value is the FCF/(WACC-g) or:

Enterprise Value = NOPLAT x (1-g/ROIC)/(WACC-g)

Adjusting for growth and the mathematics of using the subsequent period cash flow, if the terminal period is time period t, and the terminal growth rate is g, then:

$$EV = NOPLAT_t \times (1+g) \times (1-[g/(1+g)]/ROIC)/[WACC-g]$$

Derivation of the formula does demonstrate that the growth rate applied in the formula is the growth rate in invested capital which is not necessarily the same as the growth rate in EBITDA or sales as explained below. As with the equity based formula, the formula for enterprise value can be expressed in terms of the current return implied in the NOPLAT and the return that is implied in future growth as shown below.

$$\text{Enterprise Value} = \text{Invested Capital} \times ROIC_1 \times (1 - \text{asset growth}/ROIC_2)/(WACC - \text{asset growth})$$

The formula can be used to demonstrate that when the incremental future return equals the cost of capital, the growth rate does not matter in establishing the enterprise value. Here, the formula boils down to the simple perpetuity formula and the value of the company is simply the current level of invested capital multiplied by the ROIC divided by the cost of capital. To work though this formula, assume that ROIC = WACC, then:

$$\text{Enterprise Value} = \text{Invested Capital} \times ROIC_1 \times (1 - g/WACC)/(WACC - g)$$

$$\text{Enterprise Value} = \text{Invested Capital} \times ROIC_1 \times ((WACC - g)/WACC)/(WACC - g)$$

The term WACC-g falls out of the equation and enterprise value becomes:

$$\text{Enterprise Value} = \text{Invested Capital} \times ROIC_1/WACC$$

Where the return on capital equals the invested capital on future assets, the value of a company all comes from the existing assets and the return on those assets relative to the cost of capital. Here, it is not necessary to worry about future growth and the long-term prospects for the company. The value of the company is more analogous to project finance investments and the fact that a corporation is supposed to last indefinitely does not matter.

## Example of Working Capital shows that the Value Driver Formula is not only a Black Box but it is Just Plain Wrong in Deriving the EV/EBITDA Ratio

As with the formula for equity returns, a big problem with the value driver formula is that it is difficult and unintuitive with respect to the definition and interpretation of returns. This is a big enough problem that many would argue renders the formula useless. But difficulties with the formula are even worse when one delves into the formula in more detail and applies on an enterprise value basis rather than a simple equity basis. By working through the details of the value driver formula when growth rates or returns change, it becomes clear that not only is the formula almost impossible to interpret, it does not produce a correct valuation. As in other cases in this part of the book, to demonstrate how various valuation issues are applied, working capital is the starting point. One would think that a hypothetical case with no taxes, no capital expenditures, no depreciation and no deferred taxes would not have any biases in valuation. However when working through a simple case where a company has nothing other than working capital, you are forced to understand items that cause biases in the formula.

To work through the working capital analysis, assume that you have some sort of retail or trading business in Abu Dhabi (you pay no taxes and you have virtually no plant investment). Your primary investment is inventory. Currently you have one store that is earning a good return of 20%. But new retail stores will be more competitive and only earn a return of 12%. Further, assume the cost of capital for the business enterprise is 9%. The next couple of paragraphs demonstrate that the value driver formula does not correctly value this very simple case because it is impossible to construct a case where cash flow grows at the same rate as the working capital investment and the rate of return on new investment differs from the rate of return on existing plant.

To understand the problems with the value driver formula in this simple situation with only working capital investment, consider a couple of formulas in a case where there is no change in the rate of return. If the return on incremental investment is the same as the return on existing investment, the value driver formula does work. Further, the formula produces the same result as the stable growth rate formula. The case without changes in the rate of return provides a base for illustrating problems when the growth rate changes.

If there is no depreciation and taxes, then EBITDA is the same as NOPLAT and if working capital is the only asset, then invested capital is equal to working capital. If the return remains constant then the growth rate in investment is the same as the growth rate in NOPLAT. If working capital is the only asset on the balance sheet, the ratio of working capital to EBITDA has the same information as the return on investment.

If there is only working capital, the ROIC depends on the management of working capital. If you are going to increase the return on invested capital, then you must manage working capital more efficiently. On the other hand if the ROIC declines, then the management has become worse. Nothing else effects ROIC. If the growth rate in working capital remains constant, but the incremental ROIC declines from the current ROIC, then the EBITDA growth must decline. There is nothing else that can happen. There is nowhere else to go. Then the EBITDA will have a different growth rate from the growth in invested capital. But the growth in EBITDA does not equal the growth in invested capital. The growth rate in EBITDA inflow is lower than the growth rate in working capital outflow and the basic formula does not work. It is not possible to change the ratio of working capital investment to EBITDA without changing the rate or return and vice versa:

Working Capital Ratio = Working Capital Investment/EBITDA

Working Capital Ratio = Invested Capital/EBITDA

But,

Return on Investment = EBITDA/Invested Capital

Which means,

Return on Investment = 1/Working Capital Ratio

These formulas imply that if a 20% return on investment is assumed, then the working capital ratio is 1/20% or 500%. If the growth rate is 5%, and the initial value amount of working capital is 100, the theoretically correct value from computing (1) working capital investment is defined by the 5% growth; (2) EBITDA is computed through dividing the working capital investment by 500%; (3) free cash flow to the firm is the EBITDA less the changes in working capital; and (4) the value of the firm is the present value of cash flows over a long-term period. The theoretical valuation is illustrated in the excerpt below:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assumptions** | | | | | | | | | | | | |
| WC to EBITDA - History | 500% | | Explicit Growth | | | 5% | | | | | | |
| WC to EBITDA - Projected | 500% | | Terminal Growth | | | 5% | | | | | | |
| Explicit Rate of Return | 20% | | WACC | | | 9% | | | | | | |
| Long Term Rate of Return | 20% | | | | | | | | | | | |
| **Time Line** | | | | | | | | | | | | |
| Period | 0 | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| History | 5% | 500% | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE |
| Explicit | 5% | 500% | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE | FALSE |
| Long-term | 5% | 500% | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE |
| Terminal | | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | FALSE | FALSE | FALSE | FALSE |
| **Operating Model** | | | | | | | | | | | | |
| Growth Rate | | | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% |
| Working Capital | | 100.00 | 105.00 | 110.25 | 115.76 | 121.55 | 127.63 | 134.01 | 140.71 | 147.75 | 155.13 | 162.89 |
| EBITDA as Pct of WC | | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% | 500.00% |
| EBITDA | | 20.00 | 21.00 | 22.05 | 23.15 | 24.31 | 25.53 | 26.80 | 28.14 | 29.55 | 31.03 | 32.58 |
| Change in WC | | | 5.00 | 5.25 | 5.51 | 5.79 | 6.08 | 6.38 | 6.70 | 7.04 | 7.39 | 7.76 |
| FCFF | | | 16.00 | 16.80 | 17.64 | 18.52 | 19.45 | 20.42 | 21.44 | 22.51 | 23.64 | 24.82 |
| Return | | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% | 20.00% |
| **Theoretically True Value** | **536.03 €** | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 21.44 | 22.51 | 23.64 | 24.82 |

When return does not change, the stable growth formula in a previous chapter defines the same value. The formula for stable working capital [WC/EBITDA x EBITDA x g/(1+g)] can be subtracted from EBITDA and then applied in the formula FCFF x (1+g)/(WACC-g). This yields the same value as the theoretical value from assuming cash flow keeps growing for a couple hundred years. Alternatively, the value can be established by applying the value driver formula with 20% return, 5% growth and 9% cost of capital to NOPLAT (which is the same as EBITDA):

$$EV = NOPLAT_t \times (1+g) \times (1-[g/(1+g)]/ROIC)/[WACC-g]$$

$$536.03 = 26.8 \times 1.05 \times (1-[.05/1.05]/20\%)/[9\%-5\%]$$

The problem with the value driver formula is demonstrated when the simple case is changed to reflect changing returns. Here, after a defined period, the working capital investment which still grows at 5% is segregated between one part that continues to earn 20% and the remainder that reflects the growth. The investment over and above the base working capital is assumed to earn a lower return of 12% (which is still above the cost of capital of 9%). The EBTDA on the two investments can be summed and the change in working capital can be subtracted from the EBITDA to establish the free cash flow. This free cash flow can be valued using the 9% WACC to establish the theoretical value as illustrated below:

| Assumptions | | | |
|---|---|---|---|
| WC to EBITDA - History | 500% | Explicit Growth | 5% |
| WC to EBITDA - Projected | 833% | Terminal Growth | 5% |
| | | | |
| Explicit Rate of Return | 20% | WACC | 9% |
| Long Term Rate of Return | 12% | | |

| Valuation with Change in Return | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Working Capital | | 100.00 | 105.00 | 110.25 | 115.76 | 121.55 | 127.63 | 134.01 | 140.71 | 147.75 | 155.13 | 162.89 |
| Existing Working Capital | | | 105.00 | 110.25 | 115.76 | 121.55 | 127.63 | 134.01 | 134.01 | 134.01 | 134.01 | 134.01 |
| | | | | | | | | | | | | |
| New Working Capital | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.70 | 13.74 | 21.12 | 28.88 |
| | | | | | | | | | | | | |
| Existing WC Ratio | | 500% | 500% | 500% | 500% | 500% | 500% | 500% | 500% | 500% | 500% | 500% |
| New WC Ratio | | 833% | 833% | 833% | 833% | 833% | 833% | 833% | 833% | 833% | 833% | 833% |
| | | | | | | | | | | | | |
| EBITDA from Existing Assets | | | 21.00 | 22.05 | 23.15 | 24.31 | 25.53 | 26.80 | 26.80 | 26.80 | 26.80 | 26.80 |
| EBITDA from New Investments | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 1.65 | 2.53 | 3.47 |
| | | | | | | | | | | | | |
| EBITDA | | 20.00 | 21.00 | 22.05 | 23.15 | 24.31 | 25.53 | 26.80 | 27.61 | 28.45 | 29.34 | 30.27 |
| EBITDA Growth | | | 5.00% | 5.00% | 5.00% | 5.00% | 5.00% | 0.05 | 3.00% | 3.06% | 3.12% | 3.17% |
| WC Change | | | 5.00 | 5.25 | 5.51 | 5.79 | 6.08 | 6.38 | 6.70 | 7.04 | 7.39 | 7.76 |
| FCFF | | | FALSE | FALSE | FALSE | FALSE | FALSE | FALSE | 20.91 | 21.41 | 21.95 | 22.51 |
| **True Theoretical Value** | 373.73 | | | | | | | | | | | |
| | | | | | | | | | | | | |
| NOPAT | | | FALSE | FALSE | FALSE | FALSE | FALSE | 28.14 | FALSE | FALSE | FALSE | FALSE |
| Multiplier: (1-g/(1+g)/ROIC)/(WACC-g) | 12% | 5% | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 | 15.08 |
| | | | FALSE | FALSE | FALSE | FALSE | FALSE | 424.36 | FALSE | FALSE | FALSE | FALSE |
| **Value from Value Driver Formula** | 424.36 | | | | | | | | | | | |

When the working capital and returns are segregated, it is impossible to keep the growth in free cash flow equivalent to the growth in investment because the return has no degrees of freedom relative to the working capital ratio. The difference in effective growth means that valuation from the value driver formula does not correspond to the true theoretical value as shown above. In the scenario shown above, the value driver formula overstates the true value by 14%. In this simple hypothetical example with only working capital, the error implicit in the value driver formula depends on the rate of return difference and the growth rate. If there is no rate of return difference or if the growth rate is zero, the value driver produces the correct value (this is just the stable growth). But when returns are not equivalent or growth is not zero, the mathematics of the value driver formula do not work. The table below illustrates errors for different combinations of return differences and growth.

| | | Growth Rate | | | | |
|---|---|---|---|---|---|---|
| | | **0%** | **2%** | **4%** | **6%** | **8%** |
| Return | **22.00%** | 0.00% | -1.60% | -3.41% | -5.42% | -1.12% |
| | **20.00%** | 0.00% | 0.00% | 0.00% | 0.03% | 7.13% |
| | **18.00%** | 0.00% | 1.46% | 3.31% | 5.75% | 16.61% |
| | **16.00%** | 0.00% | 2.69% | 6.31% | 11.47% | 27.38% |
| | **14.00%** | 0.00% | 3.52% | 8.58% | 16.53% | 39.09% |
| | **12.00%** | 0.00% | 3.67% | 9.35% | 19.34% | 49.79% |
| | **10.00%** | 0.00% | 2.64% | 7.06% | 15.98% | 50.35% |
| | **8.00%** | 0.00% | -0.60% | -1.70% | -4.31% | -17.13% |

## Problem Number Three: The Value Driver Formula Has Even More Problems When Invested Capital includes Net Plant

Instead of assuming that a company only has working capital, one could also pretend that investment only includes capital expenditures associated with plant investment. Issues that led to distortions in value for the case of working capital apply in the same way to plant investment, but there are a few additional

problems. If the plant investment somehow did not depreciate, the ratio of EBITDA to plant would be analogous to the ratio of working capital to EBITDA. Return on investment would be defined as EBITDA divided by net plant which means that when the rate of return changes, the ratio of plant to EBITDA must also change. If the plant balance to EBITDA changes and the growth rate in EBITDA changes, then the growth rate in EBITDA cannot be the same as the growth in investment. Since the growth rate in cash flow (EBITDA) is not the same as the growth rate in investment, the value driver with the investment growth rate input does not equal the correct value of the EBITDA.

In addition to the problems that are analogous to working capital there are more problems with applying the value driver formula arise for depreciating assets. First, the level of future capital expenditures depends on the growth rate of existing assets as discussed above at length in the chapter on stable capital expenditure to depreciation. That analysis demonstrated with different historic growth rates, the true theoretical value of the firm changes. But the historic growth rate is nowhere in the value driver formula. If there is no input for the historic growth, the formula cannot account for the way in which historic growth affects future capital expenditures. Second, when depreciating assets are included in the analysis, existing assets do not remain constant but instead they decline with accumulated depreciation. This is unlike the case for working capital investment or equity investment where existing assets remained flat. If the return on new assets is less than the return on existing assets and if the existing assets decline, this stream of income from existing assets declines. As the value driver formula overstates value even when existing assets do not decline, the problem is aggravated for depreciating assets.

To measure errors in valuation that arise from applying the value driver formula, the theoretical analysis developed to evaluate stable ratios of capital expenditures to depreciation and stable ratios of deferred tax to capital expenditures can be adjusted. The level of plant still grows at the rates input, but now the EBITDA generated from the net plant changes when the assumed return changes. As the net plant depends on future capital expenditures and future capital expenditures depend on historic growth, the return depends on historic growth as well as future growth. In comparing the value driver formula to the true theoretical value, different scenarios demonstrate that the error can become large. In a case where the existing return equals the incremental return and the growth rate is zero, the value driver formula does result in a correct valuation. However as soon as these growth and return assumptions are relaxed, the value driver results in erroneous valuations. The excerpt below shows three cases. In the first case the return does not change but the future growth rate is different from projected terminal growth. In the second case the growth rate is the same, but the return changes. In the third case, both the growth rate and the return changes. All of the cases produce erroneous valuations and the error can be quite high.

| | | | |
|---|---|---|---|
| Current Return | 15.00% | Historic Growth | 10% |
| Incremental Return | 15.00% | Terminal Growth | 5% |
| | Value | Pct Difference | Multiple of NOPLAT |
| Theoretically Correct Value | 963.37 | | 13.57 |
| Value with Driver Formula | 925.04 | -4.0% | 13.03 |

| | | | |
|---|---|---|---|
| Current Return | 20.00% | Historic Growth | 5% |
| Incremental Return | 12.00% | Terminal Growth | 5% |
| | Value | Pct Difference | Multiple of NOPLAT |
| Theoretically Correct Value | 284.73 | | 8.92 |
| Value with Driver Formula | 367.50 | 29.1% | 11.52 |

| | | | |
|---|---|---|---|
| Current Return | 20.00% | Historic Growth | 10% |
| Incremental Return | 12.00% | Terminal Growth | 5% |
| | Value | Pct Difference | Multiple of NOPLAT |
| Theoretically Correct Value | 819.23 | | 8.65 |
| Value with Driver Formula | 1,089.97 | 33.0% | 11.52 |

# Chapter 33: Computing an Implied P/E Ratio in Terminal Value Calculations with Explicit Assumptions with Respect to Returns, Growth and the Cost of Capital

If you spend time watching financial analysts on television sounding highly intelligent in their opinions about the value of a stock, they generally pontificate about both the projected earnings and the valuation. The analysts generally make some kind of earnings projection (that is often optimistic) and then apply a future P/E ratio to the projected earnings to arrive at what they think the future price will be. What they have done is compute equity cash flow rather than free cash flow. The future earnings multiplied by the P/E is the terminal value and the dividends received during the intermediate period are like the explicit free cash flow. These valuations are analogous to the DCF except the valuation is made with equity cash flow rather than free cash flow. When computing the future stock price using a future P/E ratio, the financial analysts often seem to have some kind of magic way to project the future P/E ratio that drives the valuation.

The next two chapters discusses techniques to evaluate multiples -- principally the P/E ratio and the EV/EBITDA ratio -- for purposes of computing terminal value (and take the magic out of process). Using a multiple involves multiplying the EBITDA in the terminal year by an EV/EBITDA multiple. If this approach is applied, the terminal value is no longer directly sensitive to the discount rate and the growth rate as illustrated by the simplicity of the formula for terminal value:

$$\text{Terminal Value}_t = \text{EV/EBITDA x EBITDA}_t$$

The big advantages of using multiples is that the range in values resulting from differences in the cost of capital are generally much less than ranges that result from the growth rate formula. For companies that are already in a relatively stable phase with low growth and returns close to the cost of capital the method is logical. When using a multiple for computing the terminal value, the range in valuations declines dramatically as illustrated in the two tables below. The first table (using the DATA TABLE tool in excel) illustrates the wide range in value that arises from variation in the WACC and terminal growth rates. The second table demonstrates the much smaller valuation that occurs when the EV/EBITDA ratio is used instead of the growth rate.

| | | Growth | | | | |
|---|---|---|---|---|---|---|
| | | 0% | 1% | 2% | 3% | 4% |
| WACC | 7% | 24.9x | 27.8x | 32.0x | 38.1x | 48.4x |
| | 8% | 21.4x | 23.5x | 26.3x | 30.1x | 35.9x |
| | 9% | 18.8x | 20.3x | 22.2x | 24.8x | 28.4x |
| | 10% | 16.7x | 17.8x | 19.2x | 21.0x | 23.4x |
| | 11% | 14.9x | 15.8x | 16.9x | 18.2x | 19.9x |

| | | Terminal EV/EBITDA Ratio | | | | |
|---|---|---|---|---|---|---|
| | | 9.0x | 9.5x | 10.0x | 10.5x | 11.0x |
| WACC | 7% | 18.6x | 19.2x | 19.7x | 20.3x | 20.9x |
| | 8% | 17.5x | 18.1x | 18.6x | 19.1x | 19.6x |
| | 9% | 16.5x | 17.0x | 17.5x | 18.0x | 18.5x |
| | 10% | 15.6x | 16.0x | 16.5x | 17.0x | 17.4x |
| | 11% | 14.7x | 15.1x | 15.6x | 16.0x | 16.4x |

There are two big disadvantages to applying multiples in the terminal value. First, if the growth rate, the return or the cost of capital changes from the explicit period to the terminal period, the multiples should change and you cannot take the numbers from some kind of comparative analysis. Second, the EV/EBITDA multiples from comparative analysis are subject to manipulation of samples and that the EV/EBITDA multiples are not adjusted for differences in the company value as the growth rate of the company slows and as its return may converge to its cost of capital. Academics who complain about using multiples in the DCF model insist that that the multiple that currently exists when making comparisons of current companies cannot be used in terminal value calculations.

Use of a multiple such as the EV/EBITDA ratio means that the valuation depends on the opinions of other people. To demonstrate the problem with applying multiples, recall the discussion of valuing homes

before the financial crisis of 2008. Appraisers would play games with comparative samples where houses that sold for relatively low value would be excluded from the sample while homes with a high selling price – perhaps because of better features such as location – would be included. As the appraiser arrived at a higher value, the loan would be more and the selling price would be more. The higher selling price of the home in question would then be used in the next appraisal and a viscous circle would be created. To illustrate similar problems in making valuations using multiples, the excerpt below demonstrates how samples in deriving multiples can be very subjective and generally lack logic. The case involves a small freight airline company with a market capitalization of USD 175 million to that was compared with Federal Express with a market capitalization then of USD 5.971 billion.

Table 3
Valuation Table

Air Freight Company Comparables

Share prices as of close: 5/30/97

| | | 52 week: | | | YTD | | EPS | | | | P/E | | | P/EBITDA | | | Ent.Value/EBITDA | | | P/E vs. SP500 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ticker | Price | High | Low | Mkt. Cap. | Perf. | FY96A | FY97E | FY98E | P/B | FY96A | FY97E | FY98E | FY96A | FY97E | FY98E | FY96A | FY97E | FY98E | FY96A | FY97E | FY98E |
| ATLS | $ 28.75 | $ 59.75 | $ 19.88 | $ 645.4 | -39.8% | $ 1.88 | $ 2.10 | $ 2.50 | 3.0x | 15.3x | 13.7x | 11.5x | 1.5x | 1.1x | 0.9x | 8.9x | 6.4x | 5.0x | 0.74x | 0.72x | 0.64x |
| KTTY | 16.75 | 17.25 | 8.00 | 175.1 | 67.5% | 0.98 | $ 1.15 | $ 1.45 | 2.9x | 17.1x | 14.6x | 11.5x | 9.5x | 5.2x | 4.2x | 10.3x | 5.7x | 4.6x | 0.83x | 0.76x | 0.64x |
| FDX | 52.38 | 57.88 | 36.25 | 5,970.8 | 17.7% | 3.32 | 4.24 | - | 2.1x | 15.8x | 12.4x | NA | 4.4x | 4.0x | 3.6x | 5.5x | 5.0x | 4.4x | 0.77x | 0.65x | NA |
| ABF | 38.25 | 38.38 | 19.50 | 803.3 | 63.6% | 1.28 | 3.40 | 4.00 | 1.9x | 29.9x | 11.3x | 9.5x | 3.3x | 2.6x | 2.4x | 4.8x | 3.8x | 3.5x | 1.45x | 0.59x | 0.53x |
| | | | | | | | | Mean | 2.5x | 19.5x | 13.0x | 10.9x | 4.7x | 3.2x | 2.8x | 7.4x | 5.2x | 4.4x | 0.9x | 0.7x | 0.6x |
| | | | | | | | | Adj. Mean | 1.3x | 16.4x | 13.0x | 5.3x | 3.9x | 3.3x | 3.0x | 7.2x | 5.3x | 4.5x | 0.8x | 0.7x | 0.3x |
| | | | | | | | | High | 3.0x | 29.9x | 14.6x | 11.5x | 9.5x | 5.2x | 4.2x | 10.3x | 6.4x | 5.0x | 1.5x | 0.8x | 0.6x |
| | | | | | | | | Low | 1.9x | 15.3x | 11.3x | 9.3x | 1.5x | 1.1x | 0.9x | 4.8x | 3.8x | 3.5x | 0.7x | 0.6x | 0.5x |

Note:
Enterprise Value = Market Value + LT Debt - Cash and Equivalents
ATLS = Atlas Air
KTTY = Kitty Hawk
FDX = Federal Express
ABF = Airborne Freight

Source: Company reports and Scott & Stringfellow estimates

Problems with applying the EV/EBITDA ratio in terminal value calculations related to using multiples from comparison with other companies and using multiples in current market place which are driven by short-term factors begs the question of whether an alternative approach can be used. The answer suggested in the next two chapters is computing implied multiples where the EV/EBITDA ratio can account for the return on investment, the cost of capital and the growth rate.

The value driver formula discussed in the last chapter does not work in making valuations, but the general idea of explicitly accounting for value drivers (return, growth and cost of capital) in computing terminal value and multiples is an attractive idea. Instead of using the value driver formula, you can create a function that accepts inputs for (1) historic growth; (2) projected growth; (3) current return on invested capital; (4) prospective return on invested capital; (5) working capital to EBITDA; (6) book life; (7) tax depreciation rate; (8) the income tax rate; and (9) the WACC. With a user defined function that uses these inputs out will plop an EV/EBITDA ratio that you can use in terminal value and other calculations. The function can also incorporate a transition period between current growth/return and long-term growth/return. In explaining how the function is developed, a brief introduction to the use of multiples and derivation of the P/E ratio is included.

## The P/E and EV/EBITDA Ratios are Both Driven by Earned Returns, Growth and Cost of Capital; Differences between the EV/EBITDA Ratio and the P/E Ratio come from Depreciation and Capital Expenditures, Taxes and Debt

The P/E ratio and the EV/EBITDA ratios are closely related. Differences between the two ratios can be illustrated considering an extreme case for a company with no taxes, no debt and no depreciation. In this case the equity value is the same as the enterprise value and the EBITDA is the same as the net income (EBITDA minus depreciation minus interest minus taxes equals net income). Since the net income equals EBITDA and enterprise value equals the equity value in this very special case, the P/E ratio equals the EV/EBITDA ratio. This means that when factors such as growth, return and cost of capital influence the P/E ratio, these same things will affect the EV/EBITDA ratio.

To introduce the manner in which implicit multiples can be derived, the P/E ratio is computed with different long-term and short-term growth rates; different short-term and long term returns and changing cost of capital. Through explicitly considering the these factors along with transition periods, the multiples can be derived without resorting to relative valuations and without distorting the valuations for changing growth rates, returns and costs of capital. Then if you use the implied multiples in the terminal value calculation and compute those multiples from value drivers and transition factors, your valuation is driven by things like the long-term real growth rate, the difference between the ROIC and the WACC and the risk premium on the WACC.

Deriving the P/E ratio and the EV/EBITDA ratio may not be of much value in everyday valuations but understanding how to compute the P/E and EV/EBITDA ratios forces you to see what really drives the ratios and can be instructive in thinking about valuations. The process of computing the P/E ratio is somewhat easier than computing the EV/EBITDA ratio and is discussed first. To understand the drivers of value and the level of the P/E ratio and the EV/EBITDA ratio, the growth rates can be separated into short-term and long-term growth rates. Further, the cost of capital can be broken down to building blocks – the real rate of interest, the inflation rate and the risk premium. Each of these factors can be differentiated by time period as with the growth rate. The rate of return earned on investment can be expressed as the cost of capital plus a premium and this return is multiplied by the rate of investment to establish income. In modelling the P/E ratio, the drivers include: (1) the growth rate in earnings in the short-run and the long-run; (2) the rate of return earned above the cost of capital in the short-run and the long-run; (3) the rate of inflation in the short-run and the long-run; (4) the real rate of interest; and, (5) the risk premium above the nominal interest rate in the short-run and the long-run.

Valuation from the P/E analysis comes from measuring cash flow that goes into the pockets of equity holders, namely the dividends. The biggest trick in computing dividends is using the formula for the dividend payout ratio that depends on growth:

Dividend Payout = 1 - Earnings Growth/ROE

After the implied dividend payout ratio is computed, the net income per share, the book value per share and the dividends per share can be calculated through creating a table of the progression in the balance of equity invested capital. The closing balance of the equity investment is the opening balance plus the income less the dividends. The income and dividends are computed from the following formulas:

- Net Income = Return on Equity (short-term, long-term or transition) x Opening Balance
- Dividends = Dividend Payout (short-term, long-term or transition) x Net Income
- P/E Ratio = First Year Net Income/Value of Equity

Since the discount rate changes, an index of the cost of capital can be computed and the SUMPRODUCT function can be used as illustrated below:

Value = SUMPRODUCT(Dividends/Discount Index)

Computation of the P/E ratio using these ideas is illustrated below. As usual by now, the model begins with timing switches and the year by year return, payout and cost of equity are computed using the switches and the SUMPRODUCT function. Once the value is computed as the present value of the dividends, it is divided by the next year earnings to establish the ratio.

| Inputs | Short-term | Long-run | | | Outputs | |
|---|---|---|---|---|---|---|
| | | | | | Price | 19.53 |
| Inflation Rate | 1.0% | 2.50% | Initial Book Value | 10.00 | First Year Earnings | 1.31 |
| | | | Short-term Period | 5.00 | Compute P/E Ratio | 14.89 |
| Real ROE (no inf) | 12.00% | 10.00% | | | | |
| Nominal ROE | 13.12% | 12.75% | <---- =(1+Real_ROE__no_inf)*(1+Inflation_Rate)-1 | | Book Value | 10.00 |
| | | | | | Price to Book | 1.95 |
| Real CoE (no inflation) | 7.00% | 6.00% | | | | |
| Nominal Cost of Equity | 8.07% | 8.65% | <---- =(1+Real_CoE__no_inflation)*(1+Inflation_Rate)-1 | | Value from Value Driver | 18.86 |
| | | | | | PE from Value Driver | 26.68 |
| Real growth (no inf) | 5.00% | 1.00% | | | | |
| Nominal growth rate | 6.05% | 3.53% | | | | |
| Dividend Payout Ratio | 54% | 72% | <---- =1-Nominal_growth_rate/Nominal_ROE | | | |

| Period | ROE | DPO | COE | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Short-term Period | 13.12% | 54% | 8.07% | | TRUE | TRUE | TRUE | TRUE | TRUE | FALSE | FALSE | FALSE | FALSE |
| Long-term Period | 12.75% | 72% | 8.65% | | FALSE | FALSE | FALSE | FALSE | FALSE | TRUE | TRUE | TRUE | TRUE |
| ROE | =SUMPRODUCT(H21:H22*$D$21:$D$22)----> | | | | 13.12% | 13.12% | 13.12% | 13.12% | 13.12% | 12.75% | 12.75% | 12.75% | 12.75% |
| Dividend Payout | =SUMPRODUCT(H21:H22*$E$21:$E$22)----> | | | | 53.89% | 53.89% | 53.89% | 53.89% | 53.89% | 72.35% | 72.35% | 72.35% | 72.35% |
| Cost of Equity | =SUMPRODUCT(H21:H22*$F$21:$F$22)----> | | | | 8.07% | 8.07% | 8.07% | 8.07% | 8.07% | 8.65% | 8.65% | 8.65% | 8.65% |
| **Book Value** | | | | | | | | | | | | | |
| Opening Equity Balance | | | | | 10.00 | 10.61 | 11.25 | 11.93 | 12.65 | 13.41 | 13.89 | 14.38 | 14.88 |
| Add: Net Income (ROE x Opening Balance) | =H29:KU29*roe----> | | | | 1.31 | 1.39 | 1.48 | 1.56 | 1.66 | 1.71 | 1.77 | 1.83 | 1.90 |
| Less: Dividends (Payout x Net Income) | =NI*dpo----> | | | | 0.71 | 0.75 | 0.80 | 0.84 | 0.89 | 1.24 | 1.28 | 1.33 | 1.37 |
| Closing Balance | | | | 10.00 | 10.61 | 11.25 | 11.93 | 12.65 | 13.41 | 13.89 | 14.38 | 14.88 | 15.41 |
| Discount Rate Index | =G34*(1+H26)----> | | | 1.00 | 1.08 | 1.17 | 1.26 | 1.36 | 1.47 | 1.60 | 1.74 | 1.89 | 2.05 |

When deriving inputs for these value drivers, considerations include:

- The real growth rate in the long-run should not be more than the expected nominal growth rate in the economy (which some would say is the same as the real rate of interest)

- The spread between the return on equity and the cost of capital in the long-run should decline with increased competition and other factors; but it should not be zero. Without earning a return above the cost of capital, the company has no reason to be in business.

- Despite elegant theory on estimating the risk premium, a simple idea should drive the risk premium; when growth rates are lower and returns are lower, the risk is also lower. With stable growth and low earnings, the risk premium should not be much higher than credit spreads.

The first idea is to compute transition factors for growth and return in the long-term versus the short-term. If variables have time differentiation (i.e. short-term and long-term values), it is generally not reasonable to assume that the change in the variable suddenly changes in one year. Instead, the variable should gradually change from the short-term rate to the long-term rate. The period over which the variables gradually change is called the transition period. This means the transition period as well as the short-term period should be defined (the long term period is not necessary because it is the sum of the short-term period and the transition period.) In computing values over the transition period, the following two formulas can be used to interpolate assuming a long-term and short-term ROE:

$$ROE_t = (1 + g) \times ROE_{t-1} \text{ where:}$$

$$g = (ROE_{long\ term}/ROE_{short\text{-}term})^{(1/(1+transition\ period))} \text{ or,}$$

$$ROE_t = ROE_{t-1} + \text{Linear Factor} \quad \text{where:}$$

$$\text{Linear Factor} = (ROE_{long\text{-}term} - ROE_{short\text{-}term})/(1+transition\ period)$$

Considerations about whether to use the growth rate formula or the linear formula depend on whether it is possible to have a negative ROE (or other factor that will be subject to transition and interpolation). If there is a negative number, the more elegant growth rate formula does not work while the less fancy linear factor still applies.

# Chapter 34: Computing an Implied EV/EBITDA Ratio in Terminal Value Calculations with Explicit Assumptions with Respect to ROIC, Alternative Growth in Capital Expenditures or Revenues, Plant Lives, Tax Rates, Working Capital and Tax Depreciation

The last chapter explained that if there were no taxes, no capital expenditures with associated depreciation and if there was no debt, the P/E ratio and the EV/EBITDA ratio would be the same. This implies that if you want to compute the implied EV/EBITDA ratio, you can use similar ideas as in the P/E ratio, but factors for tax rates, depreciation rates, working capital and deferred taxes should be included in the analysis. In developing the implied EV/EBITDA ratio rather than the implied P/E ratio from value drivers, the process involves creating a table of net invested capital rather than the equity balance. Invested capital can be evaluated using either a table of assets or a table of financing obligations including equity and net debt. Recall that one can begin with common equity and net debt to compute invested capital or alternatively, one can begin with net plant, goodwill, net working capital and deferred taxes. The process of computing the EV/EBITDA ratio works best using the asset side of the balance sheet rather than financing obligations. Net assets grow by capital expenditures and net working capital changes and the net assets are reduced by deferred tax changes.

To demonstrate mechanics of the computing the implied EV/EBITDA ratio from value drivers, the discussion begins by a case with net plant but without working capital or deferred taxes. The analysis uses inputs for: (1) return on invested capital; (2) weighted average cost of capital; (3) capital expenditures to depreciation; (4) depreciation rate on net plant; and (5) the tax rate. The capital expenditure to depreciation ratio and the net depreciation rate can be established by user-defined functions using the book life of the plant and the asset growth rate as explained in earlier chapters. Deriving the capital expenditures to deprecation and the net depreciation rate from the growth rate and plant life is analogous to computing the dividend payout ratio from the growth rate.

The first step of calculating the EV/EBITDA ratio is computing the investment balance as illustrated in the table below. This is analogous to computing the balance of the equity capital for deriving the P/E ratio. In the case of net investment, the balance decreases from depreciation expense and it increases from capital expenditures. The depreciation expense can be calculated from the opening balance multiplied by the net depreciation rate. Once the depreciation is established, the capital expenditures can derived from multiplying the amount by the ratio of capital expenditures to depreciation. After you have computed the net investment balance, the NOPLAT or net operating profit less adjusted taxes can be computed as the rate of return on invested capital multiplied by the opening balance of the investment. Because NOPLAT is equal to EBIT x (1-tax rate), the EBIT can be derived as the NOPLAT/(1-tax rate). After computing EBIT, the depreciation expense that has already been computed can be added to the EBIT to derive the EBITDA. With EBITDA, EBIT, the tax rate and capital expenditures, items for cash flow are available. The present value of cash flow is the enterprise value and the EV/EBITDA can be computed as illustrated below.

| | A | B | C | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | | | | | | | | | | | | |
| 10 | **Assumptions** | | | | | | | | | | | |
| 11 | | ROIC (Real) | 12.0% | | | | | | | | | |
| 12 | | WACC (Real) | 7.0% | | | **EV = NPV FCF** | **3,487.82 €** | <---- =NPV(C17,39:39) | | | | |
| 13 | | Growth Rate (Real) | 5.0% | | | **EBITDA** | **337.69** | | | | | |
| 14 | | Inflation | 2.0% | | | | | | | | | |
| 15 | | Growth Rate Nominal | 7.1% | <---- =(1+C13)*(1+C14)-1 | | **EV/EBITDA** | **10.33** | | | | | |
| 16 | | ROIC Nominal | 14.2% | <---- =(1+C11)*(1+C14)-1 | | | | | | | | |
| 17 | | WACC Nominal | 9.1% | <---- =(1+C12)*(1+C14)-1 | | | | | | | | |
| 18 | | Tax rate | 38% | | | | | | | | | |
| 19 | | Depreciation life (yrs) | 15 | | | | | | | | | |
| 20 | | Net Plant Depreciation Rate | 10.80% | <---- =net_depreciation_rate(C19,C15) | | | | | | | | |
| 21 | | Capital Expenditure to Depreciation | 165.73% | <---- =cap_exp_depreciation_simple(C19,C15,1) | | | | | | | | |
| 22 | | | | | | | | | | | | |
| 29 | **Model** | | | | | | | | | | | |
| 30 | | Opening Balance | | | 1,000.00 | 1,071.00 | 1,147.04 | 1,228.48 | 1,315.70 | 1,409.12 | 1,509.17 | 1,616.32 |
| 31 | | Less: Depreciation | 10.80% | =F30*$C$31----> | 108.01 | 115.68 | 123.89 | 132.69 | 142.11 | 152.20 | 163.01 | 174.58 |
| 32 | | Add: Capital Expenditure | 165.73% | =$C$32*F31----> | 179.01 | 191.72 | 205.33 | 219.91 | 235.53 | 252.25 | 270.16 | 289.34 |
| 33 | | Closing Balance | | 1,000.00 | 1,071.00 | 1,147.04 | 1,228.48 | 1,315.70 | 1,409.12 | 1,509.17 | 1,616.32 | 1,731.07 |
| 34 | | | | | | | | | | | | |
| 35 | | NOPLAT = ROIC x Investment | 14.2% | =$C$35*F30----> | 142.40 | 152.51 | 163.34 | 174.94 | 187.36 | 200.66 | 214.91 | 230.16 |
| 36 | | EBIT = NOPLAT/(1-t) | 38% | =F35/(1-$C$36)----> | 229.68 | 245.98 | 263.45 | 282.15 | 302.19 | 323.64 | 346.62 | 371.23 |
| 37 | | EBITDA = EBIT + Depreciation | | =F36+F31----> | 337.69 | 361.66 | 387.34 | 414.84 | 444.30 | 475.84 | 509.63 | 545.81 |
| 38 | | | | | | | | | | | | |
| 39 | | Free Cash Flow (EBITDA - Cap Exp - EBIT x t) | | =F37-F32-F36*$C$36----> | 71.40 | 76.47 | 81.90 | 87.71 | 93.94 | 100.61 | 107.75 | 115.40 |

As with other subjects discussed in this part of the book, you can develop a function to compute the EV/EBITDA. This function accepts the three drivers along with the life and ant the tax rate and works through the same equations. This function is the base for adding deferred taxes and working capital to the analysis as well as differentiating between long-term and short-term parameters. After including these items, the EV/EBITDA ratio can be derived from the lifetime of plant, the tax depreciation life and method, the growth rate in assets, and the ratio of working capital to EBITDA.

```
Function EV_EBITDA_Simple(ROIC, WACC, Growth, Life, Tax_Rate)

cap_exp_ratio = cap_exp_depreciation_simple(Life, Growth, 1)        ' Use other function to compute the cap_exp to depreciation
depreciation_ratio = net_depreciation_rate(Life, Growth)            ' Use other function to compute the net depreciation rate

net_investment = 1000                                               ' Initialise variables
PV_factor = 1

For i = 1 To 300
    NOPLAT = net_investment * ROIC                                  ' Compute amounts on OPENING BALANCE
    EBIT = NOPLAT / (1 - Tax_Rate)
    depreciation = depreciation_ratio * net_investment
    cap_exp = cap_exp_ratio * depreciation
    EBITDA = EBIT + depreciation
    FCFF = EBITDA - cap_exp - EBIT * Tax_Rate

    If i = 1 Then EBITDA_1 = EBITDA                                  ' Remember the EBITDA
    PV_factor = PV_factor * (1 + WACC)                               ' Accumulate the PV factor

    EV = EV + FCFF / PV_factor

    net_investment = net_investment + cap_exp - depreciation         ' Closing balance after everything else
Next i

EV_EBITDA_Simple = EV / EBITDA_1                                     ' Compute the function on next period EBITDA

End Function
```

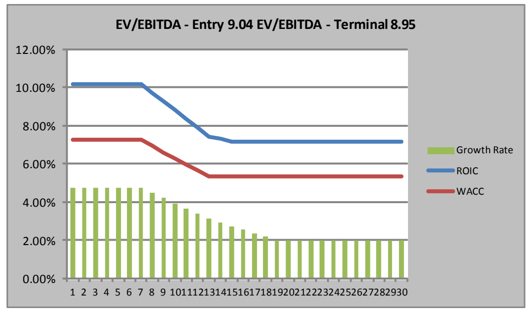
The excerpt below illustrates results of an analysis that includes periodic value drivers, transition time periods, deferred taxes and working capital. In this figure, the EV/EBITDA ratio is computed from simulation of free cash flow, the growth rate and the cost of capital along with transition factors. All of the factors that drive the EV/EBITDA ratio are included in the figure including the life of the assets, tax rates, transition factors, rates of return, costs of capital and growth rates. The table at the bottom left of the excerpt compares the implied EV/EBITDA ratio for the current year and for seven years in the future. In addition to computing the enterprise value through a long-term analysis, alternative methods are also presented. The value driver formula derives the formula from EV = NOPLAT x (1-g/ROIC)/(WACC-g). The growth rate method computes the enterprise value using the standard FCFF x (1+g)/(WACC-g). The excerpt illustrates that value driver formula and the growth rate formula do not produce accurate results

compared to the true value. The function for computing the EV/EBITDA can used in computing the terminal value in your models.

| | | |
|---|---|---|
| Book Life (Asset Replacement) | 25 | |
| Tax Life | 10 | |
| Tax Rate | 23.00% | |
| Working Capital to Plant | 11.00% | |
| Transition Years - Growth | 11 | |
| Transition Years - ROIC | 7 | |
| Transition Years - WACC | 5 | |
| Short Term Period | 7 | |

| | Current | Long-term |
|---|---|---|
| ROIC | 10.19% | 7.18% |
| WACC | 7.25% | 5.33% |
| Growth | 4.75% | 2.01% |

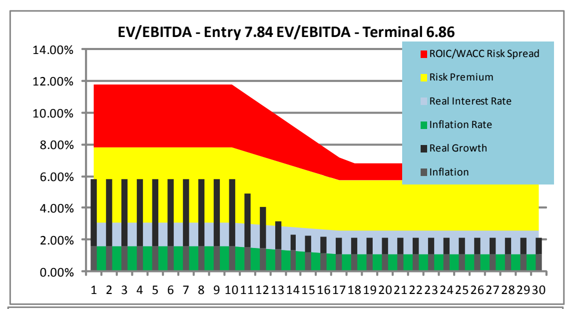
| Year of Valuation | 1 | 7 |
|---|---|---|
| **EV/EBITDA - Theoretical** | **9.04** | **8.95** |
| EV/EBITDA - Value Driver | 11.02 | 12.17 |
| EV/EBITDA - Growth Rate | 11.02 | 11.00 |

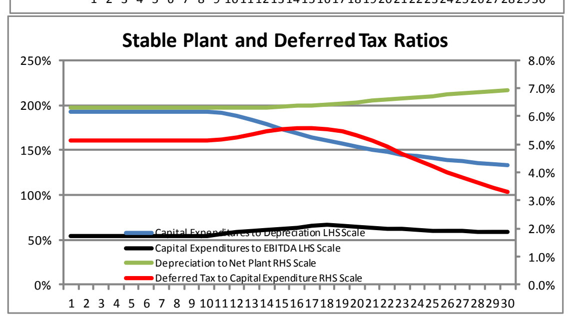



Derivation of the cash flow involves computing depreciation and capital expenditures that occurs after a change in growth rates. The manner in which capital expenditure to depreciation stabilises is shown below. In setting up a model to derive the EV/EBITDA the first step after computing growth rates, returns and the cost of capital as described above is to recognize that in order to grow, the investment in plant must increase. For example, if a manufacturing firm is to increase sales by 5% and it is operating at full capacity, then the capacity must increase 5%. If capacity increases by 5% and the price of adding capacity remains constant, then the gross investment balance must also increase by 5%. To model investments, the beginning gross investment balance must be entered.

| | | |
|---|---|---|
| Book Life (Asset Replacement) | 25 | |
| Tax Life | 10 | |
| Tax Rate | 23.00% | |
| Working Capital to Plant | 11.00% | |
| Transition Years - Growth | 3 | |
| Transition Years - ROIC | 7 | |
| Transition Years - WACC | 6 | |
| Short Term Period | 10 | |

| | Current | Long-term |
|---|---|---|
| Inflation Rate | 1.60% | 1.10% |
| Real Interest Rate | 1.50% | 1.50% |
| Risk Premium | 4.70% | 3.14% |
| Total WACC | 7.97% | 5.84% |
| ROIC/WACC Spread | 3.94% | 1.06% |
| Total ROIC | 12.22% | 6.96% |
| Real Growth Rate | 4.20% | 1.00% |
| Inflation Rate | 1.60% | 1.10% |
| Nominal Growth Rate | 5.87% | 2.11% |
| Stable Cap Exp/Depreciation | 193.11% | 160.22% |
| Depreciation/Net Plant | 6.30% | 6.43% |
| Capital Expenditures/EBITDA | 54.72% | 66.64% |
| Deferred Taxes/Capital Expenditure | 5.12% | 5.54% |




## Chapter 35: Regression Analysis of P/E, EV/EBITDA, Market to Book Ratio to See if the One Can See Relationships in Real Data

The above analysis demonstrates various factors that should affect P/E, EV/EBITDA and M/B multiples. When evaluating the P/E ratio or the EV/EBITDA ratio one can test whether these factors in fact influence the ratio. For example, if ROE is higher, the P/E ratio should increase and one should be able to partially predict the differential P/E from the differential ROE. After establishing theoretical drivers of multiples, various factors that drive the multiples can be tested using actual data with regression analysis. The regression analysis can use data on estimated growth, return and measurable cost of capital factors to arrive at multiples that can be applied in the DCF model.

The objective is ultimately to come up with a formula to predict the P/E, EV/EBITDA and M/B ratio from value drivers such as the growth rate, the return on capital, beta, the debt to capital ratio and other factors. If a formula can be established, then one can plug in independent estimates of return, growth and other items and then one can predict the valuation multiples derive the estimated value. For example, the formula could take the form:

P/E = A + B x g/ROE + C x g + D x beta + E x debt to capital + F x Size + G x Country Risk

With such a formula, one can try to explain why the P/E ratio of a company is relatively high or low. Further, if one believes that ROE is above market expectations or the growth rate is lower or the risk is increasing, the P/E ratio can be estimated from the formula. In addition, the analysis can be used to test which factor is most important in the market such as whether the predicted growth rate from stock analysts is more important than historic achieved growth rates. Similar equations can be developed for the EV/EBITDA ratio where the ROIC would replace the ROE and revenue growth would replace the earnings growth and depreciation rates, tax rates and working capital ratios would be included.